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AUTOMOBILE SCRAPPING PROCESSES AND NEEDS FOR MARYLAND

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1970

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Automobile Scrapping Processes and Needs for Maryland

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Automobile Scrapping Processes and Needs for Maryland

A FINAL REPORT ON A SOLID WASTE DEMONSTRATION

This report (SW-10d) was prepared for the Maryland State Department of Health

by MANAGEMENT TECHNOLOGY INC.

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from the Bureau of Solid Waste Management

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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Foreword

AN ESTIMATED 900 MILLION POUNDS of solid wastes of all types are produced in the United States every day. What to do with these solid wastes, how to dispose of them without needlessly endangering public health and welfare, and how to recover and reuse valuable materials now discarded are among the most challenging and perplexing of current national problems. Because of lack of suitable planning, interest, and public understanding, these problems have reached such proportions that nationwide attention is demanded and action for the development of adequate solutions must be taken.

Intensified action concerning these problems was made possible by the Solid Waste Disposal Act, Title II of Public Law 89-272, which was signed by the President on October 20, 1965. This legislation directs the Secretary of the Department of Health, Education, and Welfare to initiate, encourage, and support a national program aimed at discovering and evaluating better methods of coping with the solid waste problem.

The Secretary is authorized: (1) to conduct and support research on the nature and scope of the problem, on methods of more safely and efficiently collecting and disposing of solid wastes, and on techniques for recovering from solid wastes potentially valuable materials and energy; (2) to provide training and financial and technical assistance to local and State agencies and other organizations in the planning, development, and conduct of solid waste management programs; (3) to encourage and support projects that may demonstrate new and improved methods of solid waste collection, handling, and disposal.

To carry out these responsibilities, the Bureau of Solid Waste Management was established. Among the responsibilities with which the Bureau is charged is that of providing grant support for demonstrations relating to the development and application of new and improved methods of solid waste collection, storage, processing and ultimate disposal; and also for studies and investigations that may lead to a demonstration of improved disposal practices, or may provide solutions for regional or national solid waste disposal problems. Associated with this is the responsibility of collecting and making available by appropriate means the results of, and other information pertaining to, such federally supported demonstrations, studies and investigations.

This report attacks the problem of automobile disposal using a systems analysis approach. Although the analysis has been directed to solving the problem in Maryland, the model can be applied to other States or regions. The basic components of the disposal reclaiming cycle are discussed as well as the problems associated with each. The seven problems identified would be expected to exist in locations other than Maryland. The magnitude of the seven problems will vary, and the solutions peculiar to any location will be dependent on this magnitude. Hence, guided by the basic model presented in this report, it should be possible for those working in the field to determine the modifications that would be necessary to solve the problem of automobile disposal for any location in the United States.

—RICHARD D. VAUGHAN, *Director*
Bureau of Solid Waste Management

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Summary

CONSIDERING the abandoning, collecting, storing, disposing, salvaging, and processing of junked cars as an integrated system, we analyzed each component of the system—the Junked Car, the Abandoned Car, the Impounded Car, the Auto Dismantler, the Scrap Processor, the Scrap User—and identified seven problem areas in the system, each requiring a solution. Information regarding each component of the system was collected from Federal, State, and local governments, from auto dismantlers, steelmakers, and scrap processors, and from other available sources, including trade associations, States other than Maryland, and reports of other consulting firms. The magnitude of the scrap automobile problem in Maryland was accessed through the use of a questionnaire responded to by all the counties of Maryland and the City of Baltimore, interviews with State and local officials, and projections of the future number and distribution of junked cars in the State.

Based upon the data collected, alternative approaches to each problem were evaluated. In this evaluation, all alternatives, based on both technological changes in the private sector and suggested government actions, were analyzed to determine the effect of each on all problems and components of the system. Finally, a set of conclusions and recommendations was developed.

Problems, Conclusions, Recommendations

The seven problem areas considered, the conclusions reached concerning the activities of the private sector in each area, and the recommendations for government action, have been summarized briefly below.

Problem 1. Vehicle abandonment continues at an alarming rate. *Conclusion:* No action by the private sector will result in significantly reducing the number of vehicles abandoned annually. *Recommendation:* The passage of State legislation imposing heavy penalties on those who abandon vehicles. The retrieval of vehicle registration information will become more rapid and precise with the implementation of National Highway Safety Standard 4.4.2, which requires an integrated motor vehicle registration program, thereby assuring the ability to trace ownership.

Problem 2. A vast inventory of abandoned vehicles requires location and collection. *Conclusion:* Increasing demand for vehicle hulks to feed scrap shredders that will be operating in Maryland shortly will result in the collection of some, and perhaps all, of the current inventory of abandoned vehicles. In other geographical areas, the appearance of this method of processing scrap has resulted in vehicles being drawn into these operations from as far as 500 miles. *Recommendations:* To supplement this anticipated demand for vehicle hulks, and to reduce the number of abandoned vehicles as rapidly as possible with the least expenditure of public funds, abandoned and junked vehicles should be defined as public nuisances and it should be required that they be reported and removed to junk dealers or scrap processors; free dumping areas should be established in political subdivisions at which junked cars may be deposited.

Problem 3. Current laws and titling requirements restrict vehicle collection and disposal. *Conclusion:* No action by the private sector will alleviate this problem. *Recommendation:* Reduce the legal and titling requirements currently hampering the collection and disposal of vehicles by enacting sections (b) through (g) of Senate Bill No. 16.

Problem 4. Auto dismantlers and scrap processors present air pollution and aesthetic problems. *Conclusion:* Industry initiated action to solve these problems has not been sufficient. *Recommendations:* Require screening of all extant auto dismantlers' and scrap processors' facilities from public view; require each facility to present a plan for screening within 6 months of effective date of legislation. Encourage counties and municipalities to stipulate in master plans the available locations for future dismantlers and processors and provide them with technical assistance. Permit interim controlled open burning until and subsequent to the opening of scrap shredding operations.

Problem 5. There are currently in auto dismantlers' yards a considerable inventory of vehicle hulks, that is, junked cars stripped of usable parts. *Conclusion:* This inventory will be reduced upon the initiation of shredding operations in the State of Maryland and will continue to be reduced as the quality of, and demand for, scrap increases. *Recommendation:* No government action is required to decrease the current inventory of vehicle hulks.

Problem 6. The quality of scrap produced from auto hulks using current methods frequently does not meet the quality standards of potential users. *Conclusion:* This problem has been solved by the development of the scrap shredding process. Sufficient shredding facilities will be available by mid-1969 to process all junk vehicles in the State of Maryland through at least 1979 based on our projections. *Recommendation:* No government action is required to support or subsidize the scrap industry.

Problem 7. The current production methods used by the steel and foundry industries do not generate sufficient demand for processed scrap to utilize all junked cars. *Conclusion:* The increasing use of electric furnaces and the continuous casting process by the foundry and steel industries, both of which generate considerable demand for acceptable scrap, will result in the eventual utilization of the total inventory of junked cars as a resource. *Recommendation:* No government action is required to increase the use of scrap.

In essence, then, problems created by an inadequate demand for processed scrap and a technologically unacceptable supply of processed scrap are being solved by industry. The aesthetic problems, however, require government action.

System Description

WHEN AN AUTOMOBILE has outlived its usefulness as a transportation vehicle, it becomes an aesthetic problem—but also it becomes a valuable source of materials. In a sense, it becomes a mine from which valuable metallic . . . materials can be obtained. So begins *Automobile Disposal, A National Problem,* published in 1967 by the Bureau of Mines. The problems created by the junked car as a major component of the bulky solid wastes being discarded at an ever-increasing rate in our society are the major subjects of this study. It is, moreover, the two characteristics of the junked car noted in the above quotation that provide an insight into two types of problems, each of which requires a distinct approach: first, those problems related to the junked car as an aesthetic problem, i.e., as a nuisance and an eyesore; second, those problems related to the junked car as an available, but not fully utilized, resource.

Solving those problems in the second group, the resource-related problems, is of first importance, since it is only by ensuring the rapid, and profitable, reuse of these available raw materials that the galloping growth of solid waste accumulations can be stopped. By drawing more of the resources into the production cycle, we can minimally reduce the time from the discard of obsolescent material until it is reusable as a raw material, and, optimally, reduce the inventory of unprocessed scrap and the blight resulting from the abandonment of vehicles.

The aesthetic problems, more noticeable but perhaps less significant, are more tractable to solution by government action; however, solutions to aesthetic problems are likely to be regarded unjustifiably as a cure, which they are not, rather than merely as camouflaging of the actual problem. It is only by a combination of required actions for solving the aesthetic problem and the utilization of potential resources in the junked car that significant progress can be attained.

The Approach

To better understand the problems created by the junked automobile (and other metallic solid wastes)and to ensure an integrated approach to the solution of these problems, systems analysis techniques were used to define and analyze the current and projected situation. This approach clarified the interrelationships between the problem areas and identified those actions that could result in solution of the problems and those actions that could serve only to temporarily alleviate undesirable conditions. First, a system flow chart of the scrap cycle was prepared in order to present clearly the distinct activities which comprise this cycle. Second, the individual components of this cycle were investigated and described. Third, the problems related to the components were identified. Fourth, data regarding the current magnitude of these problems in Maryland were collected by means of a questionnaire sent to all counties in Maryland and the City of Baltimore and interviews with government officials, junk and scrap dealers, and other interested persons. Fifth, land use plans for the counties of Maryland were re-

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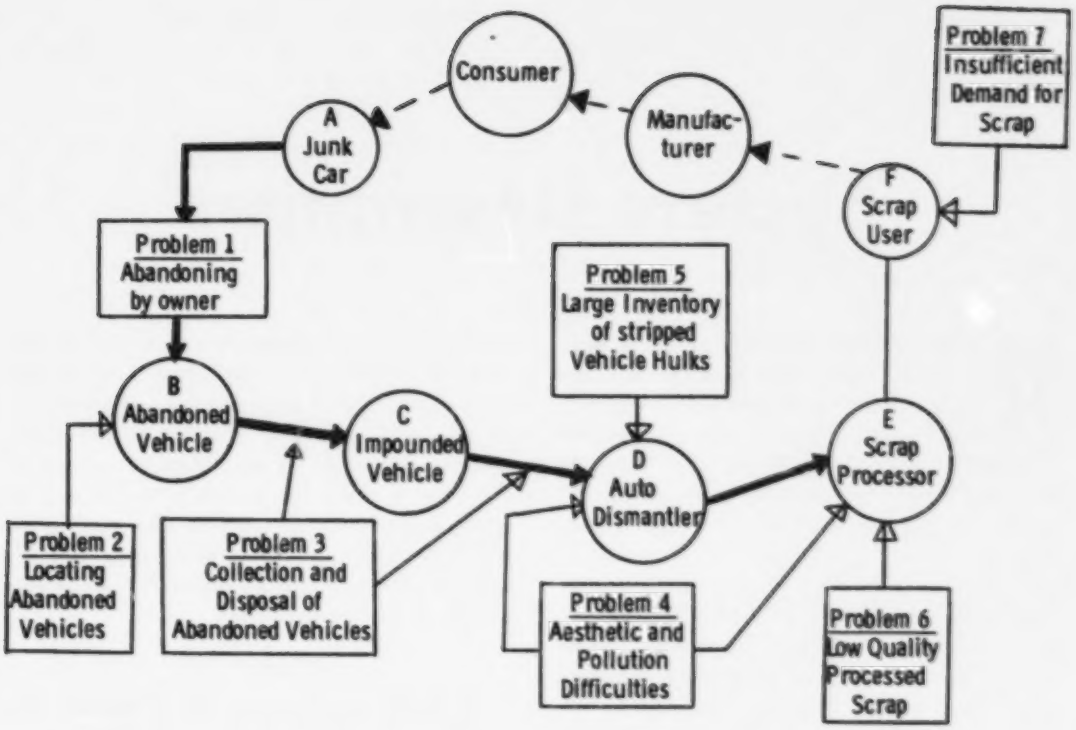

EXHIBIT I. *Disposal/Reclaiming Cycle for Junked Cars.*

viewed. Sixth, projections of the future level of disposed vehicles in Maryland were made. Seventh, alternative solutions to each problem were developed. Eighth, the alternative solutions were evaluated in light of the data collected and the current changing patterns of operation in the scrap processing and steelmaking industries; a set of recommendations was then developed.

The Junked Car—Location and Users

The first step in our analysis was to define the problem limits by charting the flow of the vehicle from the time of its ceasing to be a usable means of transportation until the reusable materials it contained were back into the manufacturing industry.

Exhibit I, Disposal/Reclaiming Cycle, depicts the flow of the vehicle through this cycle. The six sections that follow correspond to the symbols designated A through F in Exhibit I and describe briefly the following component parts of the cycle: the junked car; the abandoned vehicle; the impounded vehicle; the auto dismantler; the scrap processor; the scrap user.

The Junked Car. The junked car enters the scrap cycle when a vehicle owner decides that he no longer can use a vehicle as a means of transportation because it is: (1) inoperable and the cost of repair exceeds its value to him; (2) wrecked; or (3) because there is no demand by others for the vehicle an a means of transport.

When the vehicle owner finds himself in

this situation, he follows basically one of four courses of action: (1) he keeps the vehicle on his property; (2) he abandons the vehicle on public or private property; (3) he sells or gives the vehicle to an auto dismantler or scrap processor; (4) he takes the vehicle to a dump.

The Abandoned Vehicle. Nationally, according to a survey conducted in 1965 by the Bureau of Mines, approximately 21 percent of the total junked car inventory was in automobile graveyards, municipal car pounds, public dumps, held by the owner on his property, or abandoned on public or private property.

A 1967 report prepared by the U.S. Department of Commerce, *Motor Vehicle Abandonment,* indicated that 10 percent of the total number of cars leaving active service annually were abandoned. The reasons for abandonment, and the percentage of respondents who proffered each, are as follows: (1) the car broke down and I left it where it was (30%); (2) it costs too much to have the car removed (25%); (3) I don't know where to take the car or whom to call (25%); (4) I couldn't find the title (or) the bank had the title (10%); (5) other varied reasons (10%).

The primary causes for abandonment are then that, (a) it is the least expensive and most expeditious way to discard a no longer wanted item, and (b) no effective campaign has been conducted to advise those who have or will have this problem of the proper means of disposal.

Abandoned motor vehicles are normally in one or more of the following categories: deteriorated motor vehicles with little or no monetary value for resale; unserviceable vehicles with repair costs that exceed their value; and, vehicles which have been wrecked, misappropriated, or stolen.

Automobile graveyards are tracts of land where "abandoned" junked cars have accumulated. In the main, these vehicles do not currently find their way into the dismantler/scrap processor/steel producer cycle. The graveyards, which nationally represent about 3 percent of junked car inventory, according to the Bureau of Mines' *Automobile Disposal, A National Problem,* are principally of four types: (1) abandoned-auto wrecking yards; (2) auto dealer's storage yards for inoperative trade-in vehicles; (3) storage areas initiated by the accumulation of hulks by car repairing and rebuilding hobbyists and repair groups; (4) farm property used by the owner for a "crop of junk vehicles."

The Impounded Vehicle. When a vehicle is abandoned on public property or on private property other than that of the vehicle owner and discovered, either by observation by government personnel (primarily law enforcement officers) or by complaint, the vehicle is impounded in many instances by the local government and held in a "car pound."

After impounding, the subsequent series of actions is normally followed: (1) an effort is made to trace the vehicle ownership; (2) the owner, if located, is notified that his vehicle has been impounded and allowed time to claim the vehicle upon payment of towing, and other charges; (3) if unclaimed, and subsequent to required title clearance procedures, the vehicle is normally auctioned.

Such procedures are common in urban areas; vehicles currently abandoned in rural areas, however, are not normally impounded and, therefore, continue to blight the countryside.

The Auto Dismantler. The auto dismantler (synonymously, junk dealer) provides, basically, two services to the community by: first, accepting worn out, wrecked, or obsolete vehicles that are no longer wanted for service as a car, and, second, supplying used parts for replacement to individuals, automotive repair shops, and rebuilders.

The auto dismantler depends for his continued existence not only upon the sale of parts, but also on the sale of stripped

vehicle hulks to scrap processors. A low price from, and in some instances a charge to the dismantler by, the scrap dealer causes the inventory of hulks to accumulate in "junk yards." Nationally, auto dismantlers indicate that 23 percent of their inventory has no further value as a source of parts.

Auto dismantlers are the primary depository, and in many areas currently the only aceptable depository, for disposing of junked cars. When the scrap cycle is operating properly, that is, when the demand for processed scrap is sufficient to permit scrap processors to sell their inventories and purchase all available hulks for processing, junk vehicles flow in and out of the dismantlers' yards at virtually the same rate; reusable parts are removed from the vehicle for resale and the residue, the stripped vehicle hulk, flows forward in the cycle to the scrap processor.

The Scrap Processor. Fundamentally, the scrap processor collects scrap, processes it into the physical forms and grades required by customers, and sells it, in some instances through brokers, to steel mills and foundaries.

The scrap processor normally retains only a small working inventory of vehicle hulks. A 1965 Bureau of Mines report indicated that, nationally, only 6 percent of the total junked car inventory was in scrap processors' yards. The processors reported that for every vehicle at their facility at year's end, 16 had been processed and sold.

The Scrap User. Iron and steel scrap is used as ferrous raw material in the iron and steel industry, including foundaries. Scrap comprises about half of the metallic raw material input in steel and ferrous castings production, the balance consisting primarily of pig iron.

Scrap is used as a metallic raw material because: (1) it normally provides adequate quality metalics in competition with primary sources; (2) the price of scrap tends to be lower than primary materials to most steel producers, except in periods of material shortages. The free market sets prices at levels that make the use of scrap attractive. This attractiveness, however, varies among consumers primarily as a result of varying degrees of production integration and different types of furnaces; (3) a large quantity of scrap is produced by the steel makers themselves as a by-product of their operations. This scrap is generally of relatively high quality and of known composition.

Briefly, then, we have presented an overview of the components of the Disposal/Reclaiming Cycle.

The Problems in the Cycle

The seven primary problems in the cycle are: (1) the continuing flood of vehicle abandonments; (2) the vast inventory of abandoned vehicles which must be located and recovered; (3) the legal limitations restricting the recovery and disposal of abandoned vehicles; (4) the aesthetic and pollution problems associated with auto dismantlers and scrap processors; (5) the current inventory of stripped hulks in auto dismantlers' yards due to insufficient demand by scrap processors; (6) the quality of processed automotive scrap; (7) the production methods used currently by the steel and foundry industries.

These problems are depicted by the rectangles numbered 1 through 7 in Exhibit I, Disposal/Reclaiming Cycle for Junked Cars.

Exhibit II, Problems and Aproaches, expands the description of these seven problem areas, relates them to the system components, and lists the normally considered alternative approaches to the solution of these problems.

Before we examine that combination of activities by private enterprise and actions by government which is most likely to provide a solution to these problems, we must first assess the current and projected status of these problems in Maryland.

EXHIBIT II. THE PROBLEMS AND APPROACHES

THE PROBLEMS	THE SYSTEM COMPONENT	THE ALTERNATIVES
1. Abandoned vehicles continue to cover the countryside in ever-increasing numbers. This spreading pall must be stopped 2. The vehicles already abandoned require an integrated system of retrieval	ABANDONED AUTO	The abandonment of vehicles can be stopped, or minimally reduced, by: a) Instituting heavy fines for those who abandon a vehicle b) Placing an artificial value on a junk vehicle by paying a fee to all who turn in their obsolete auto c) Subsidizing those who retrieve abandoned auto d) Penalizing those who create scrap by demanding cars which become junk—taxing new car purchasers e) Charging manufacturers who produce items which become obsolete for the "social" costs involved in the retrieval of these items f) Informing the public of how and where to dispose of vehicles properly g) Licensing all junk dealers and defining them so that anyone who leaves an "abandoned" vehicle on his property is subject to licensing requirements
3. Current statutes often restrict both government and private action in obtaining, storing, and disposing of junked autos	IMPOUNDED AUTO	Institute state and local legislation to: a) Permit freer access to abandoned vehicles for the purpose of retrieving them b) Reduce title clearance requirements c) Stipulate maximum time allowance for owner to retrieve vehicle d) Increase charges to those who do not retrieve vehicles immediately e) Inform public of locations where vehicles can be recovered
4. The auto dismantler's facility: a) Is frequently offensive in appearance, particularly in certain areas, and b) Presents a pollution problem due primarily to the requirement for burning vehicles when they are to be processed as scrap by most current methods 5. The current inventory of hulks, that is vehicles stripped of saleable used parts, in auto dismantlers' yards, is extensive. The demand by processors for these hulks must be increased	AUTO DISMANTLER	Require that: a) Extant auto dismantlers facilities be shielded b) Future facilities be located away from areas of public congestion and/or shielded c) Effective pollution control be implemented a) Artificially support the scrap industry to permit them to expand their sales to the scrap users and to purchase more vehicle hulks from the auto dismantler
4. The scrap processor's facility is frequently not acceptable either in appearance or as a safe operation 6. The quality of scrap produced by the processors from auto hulks is frequently such that it is unacceptable to user except at extremely low prices	SCRAP PROCESSOR	a) Require that scrap processors shield their facilities in accordance with standards for the zone in which they are located a) Artificially support the scrap processing industry so that the price of technically low-quality scrap will be acceptable to scrap users b) Improve the quality of scrap by utilizing more advanced technology in its production
7. The current methods of production used by scrap users do not, at most times, allow them to utilize sufficient scrap to clear the junk auto hulks from the system	SCRAP USERS (Mills and Foundries)	a) Increase the amount of scrap consumed by expanding the use of steel and casting production methods which can utilize greater amounts of processed scrap b) Decrease the price of scrap by artificially supporting the scrap processing industry

Maryland—The Scope of the Problem

THE DATA in the following sections is intended to provide a basis against which to assess the results of the implementation of certain courses of action, which are expected to follow in the steel and scrap processing industries, and which we hope will be established by the State of Maryland.

The data in The Current Situation, was developed from the responses to our questionnaire received from government personnel of all counties of Maryland and the City of Baltimore, from interviews with government officials, from interviews with auto dismantlers and scrap processors, and from land use plans provided to us by Maryland's political subdivisions.

The data in Projected Vehicle Disposal, is the result of the application of a statistical model we developed (which correlated historical new car sales with cars junked in past years with great accuracy) to projected new car sales.

The Current Situation

The Abandoned and Impounded Vehicle. The Annotated Code of Maryland currently permits the "disposition of lost, abandoned and stolen motor vehicles" in Maryland and specifically in Anne Arundel, Montgomery, and Prince George's Counties, and incorporated municipalities. Further, county commissioners are empowered by the State to institute and implement ordinances for impounding and disposing of vehicles left on private property. Some political subdivisions have passed legislation permitting the impounding of vehicles from both public *and* private property, whereas others have ordinances covering only abandonments on public *or* private property; still others have no policy established in this regard.

In the State of Maryland, abandoned, lost, or stolen motor vehicles that are impounded by the Department of Motor Vehicles must be held for a period of 3 months, although in Anne Arundel, Montgomery, and Prince George's Counties, and in incorporated municipalities, this time period is reduced to 30 days.

If the owner, lien holder, or other person or corporation entitled to the vehicle cannot be located within the specified time limit, the vehicle may be disposed of. However, if the owner of the vehicle does not claim it, a notice describing the vehicle and the date and place of its sale must be placed in a local newspaper at least once a week for the two weeks preceding the proposed sale date. Also, a registered notice must be mailed to the last owner as shown on Department records at least ten days prior to the sale.

A special fund is created from the sale of these vehicles to cover the expenses of storing and processing them prior to auction and the balance of proceeds from the sale, after expenses, is held for 1 year by the responsible government agency for payment to the vehicle owner if he submits a claim during that time. If no claim is made within a year, this balance is transferred to the General Treasury.

An abandoned vehicle having salvage value only may be sold by the property owner or person having custody of the ve-

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hicle after 30 days. Prior to selling, a certificate stating the vehicle has salvage value only must be obtained from the Department of Motor Vehicles or the appropriate police department. Further, the vehicle owner must be notified that the abandoned vehicle will be sold unless it is promptly claimed. In addition, a notice of sale must be sent, by registered mail, to the last owner of record at least10 days prior to the sale. A certificate of sale and certification of salvage value must be obtained following the sale on forms prescribed by the Department of Motor Vehicles. This certification constitutes the certificate of title if the purchaser is an auto dismantler or scrap processor who intends to destroy the vehicle in question. The seller is absolved of any liability to the original owner if the procedures outlined above are followed.

A survey conducted in 1966 by the Division of Solid Wastes of the Maryland State Department of Health found more than 51,000 abandoned vehicles in Maryland, exclusive of Anne Arundel, Baltimore, and Frederick Counties. Although no attempt was made in this study to "count" the abandoned vehicles in Maryland, data received in response to our questionnaire indicated an abandonment rate of approximately 23,000 vehicles annually for the State (Exhibit III).

The Auto Dismantler and Scrap Processor. State trader's licenses are issued by the counties to auto dismantlers and scrap processors based on the value of their inventory and the cost of these licenses varies from $15 to $800.

The operation of auto dismantlers is governed by zoning ordinances passed by certain counties and municipalities. In some localities, prior approval by a zoning commission or certain other agencies is required to expand or open new facilities. The political subdivisions also vary widely in the restrictions placed on the size, fencing, and screening from public view, and the distance from a public highway of auto dismantlers and scrap processors.

Air pollution controls are affecting the scrappage of automobile hulks. Burning of these hulks in the open in prohibited; however, in many instances permission to burn has been granted. This permission has been granted normally after a review of the individual operation, taking into consideration the proximity of other industry, residential areas, and fire hazards.

Responses to our questionnaire resulted in the identification of approximately 700 auto dismantlers in the State, with an estimated current inventory of roughly 160,000 vehicles. Fourteen major scrap processors were identified; these had either shears or balers for the preparation of hulks for sale to mills and foundries. Two shredders are planned in the State—one to be located in Baltimore, the other in the suburbs of the District of Columbia.

Exhibit III, State and County Data—Current and Projected, presents a consolidation of the data received from the counties and the City of Baltimore in response to our questionnaire. Appendix A, County Data, is a compilation of the essential information received from county officials and land use master plans. Exhibits III through VIII may be found following the appendices at the end of this book.

Projected Vehicle Disposal

To assess future magnitude and distribution of junked cars in the State of Maryland a projection of these vehicles for the State, its counties, and the City of Baltimore was made for each year from 1968 through 1979. These estimates appear on the lower half of Exhibit III, State and County Data—Current and Projected. The method used for these projections, which is explained in detail in Appendix B, was to develop a predictive statistical model which could accurately correlate historical data with the actual number of cars leaving active service annually in past years.

The model finally selected predicted the number of vehicles leaving active service annually with extreme accuracy (within 2.5% of the actual for the State of Maryland) and was based on the number of new cars sold in the 20 years preceding the year for which scrappage data was being collected.

Having determined the efficiency of the model, new car sales for the State of Maryland and its political subdivisions were projected. This projection, which appears in Exhibit IV, New Car Sales—Actual and Projected, was developed using the linear least squares regression technique and was checked against other forecasts that had been made of new car sales (Appendix C). This projection correlated well with general industry and government estimates.

Finally, the predictive model for scrappage was applied to the projected new car sales and resulted in our estimate of future annual vehicle scrappage for Maryland, its counties, and the city of Baltimore.

The projection indicates that the number of vehicles annually leaving active service by 1979 will be close to 200,000, requiring that facilities for processing and demand for the processed scrap must reach this level by that time.

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Maryland—A Solution

IN the last part of this report, we noted that the problems with which we are concerned are of basically two types: First, problems related to the junk car as a nuisance and eye-sore, abandoned singly or in graveyards, or visible to all who pass in auto dismantlers' and scrap processors' yards; second, problems related to the junk car as an available, but not fully utilized, resource.

We will first examine, in detail, resource-related problems since government action should be directed only toward removing any residue of problems remaining after action by the private sector.

Secondly, we will discuss this residue of problems and propose government actions to remove them.

Resource Utilization

The purpose of this section is to assess the effect of certain recent technological developments in the scrap processing and steel producing industries, and to determine the extent to which current problems in the Disposal/Reclaiming Cycle will be resolved by the implementation, in Maryland, of these developments.

Technological Developments. Certain recent developments in the steelmaking and scrap processing industries indicate that the demand for processed scrap will increase significantly in the near future and that the supply will be improved technically to a sufficient degree to permit the inclusion of all junked car hulks in the scrap cycle. These developments are: (1) the increase in the percentage of steel production by electric furnaces, which use 98 percent scrap; (2) the reduction (halving) of home scrap by the expanding use of the continuous casting process; (3) the production of technically better scrap by the scrap processor, particularly when using the shredding process.

The electric arc furnace uses a high proportion of scrap—about 98 percent of the charge. This furnace has been accounting for an increasing share of the steel production, rising from 7.7 percent in 1958 to 11.6 percent in 1967, according to the 1968 Institute of Scrap Iron and Steel Yearbook, and this percentage is predicted by Union Carbide, a leading manufacturer of electrodes for those furnaces, to rise to 25 percent by 1975.

The supply of home scrap, which is scrap originated in the iron and steel industry and reused there, is being reduced substantially by a relatively new process known as continuous casting. It is estimated by the Business and Defense Service Administration (BSDA) U.S. Department of Commerce that 18. 5 percent of new steel will be continuously cast by 1970 and 38.5 percent by 1975.

Although certain types of steel cannot be continuously cast at present, the steel industry expects that the current technical limitations will be overcome in the not too distant future.

The characteristic of this process, an essential element in this study, is its elimination of approximately 50 percent of the home scrap produced using conventional methods. The following table, from the

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U.S. Department of Commerce, BSDA, Office of Metals and Minerals, presents the differences in raw material requirements between the conventional method of making steel and continuous casting, assuming the use of the current 45 percent scrap in steel making.

	By conventional method (tons)	By continuous method (tons)	Continuous casting as percent of conventional method
Gross scrap and pig iron used	158	133	84
Less home scrap	(36)	(19)	53
Net purchased scrap and pig iron used	122	114	93
Less nonrecoverable losses	(22)	(14)	64
Finished steel produced	100	100	100
Addenda:			
Purchased Scrap Used	37	41	*111*
Pig Iron Used	85	73	86

Source: U.S. Department of Commerce.

In order to make 100 tons of steel using traditional methods, 158 tons of raw materials, scrap and pig iron, are used. Of this amount, an average of 73 tons is scrap. Thirty-six tons, however, is home scrap, that is, scrap resulting from the production of steel and available to the steel manufacturer for later reuse. This scrap never leaves the plant and can simply be recycled. The balance of the scrap used, an average of 37 tons, is purchased. On the other hand, using the continuous casting process, only 60 tons of scrap are required. But this process reduces home scrap to only 19 tons and requires the purchase of 41 tons of scrap. The result is an increase of 4 tons purchased scrap for 100 tons of steel produced or an increase in scrap demanded of 11 percent.

If continuous casting were substituted for the conventional methods throughout the steel industry, however, the decline in home scrap would make it impossible to maintain the current domestic steelmaking scrap proportion, because not enough scrap, both home and purchased, would be available, even if all metallic wastes were processed and all scrap exports diverted to domestic use. If this should occur, the most likely result would be an upward shift of the demand curve for scrap; i.e., a higher price per unit for processed scrap at each quantity demanded.

In review, the demand for scrap is rising with the expanding use of electric furnaces, and the supply of home scrap is declining with the continued growth of continuous casting. These factors combine to indicate an expanding market for technically acceptable scrap.

And the new shredding process provides a solution to the problem of technically unacceptable scrap. This new process, as used by the largest scrap shredding firm, shreds automotive scrap into small pieces, from 1/2 inch to 8 inches in length and width. The process next magnetically takes out much of the nonferrous materials. The shredded ferrous scrap is then heated in order to melt or burn off some of the remaining nonferrous metals and other materials. This hot shredded material then moves through a rolling process which compresses it and breaks loose additional contaminants. The material is then passed over a second magnetic separator. The resultant material is shredded scrap.

Perhaps the best measure of the technical acceptability of shredded scrap is the fact that it is reported as selling at appreciably higher prices than No. 1 heavy melting scrap, which normally sells for about 30 percent more than No. 2 bundles, the traditional processed form of a junk auto hulk. (Appendix D presents a list of prices currently paid by a shredder in Massachusetts for vehicle hulks). Further, this method of processing eliminates the

problem of open burning. Finally, the combination of a high quality product with an acceptable price has resulted in large shredding plants reaching out as far as 500 miles to find enough cars for processing.

An early appearance of shredders was in Southern California, and, currently, no junked car problem exists in the areas reached by these operations, which include most of California and the western parts of Nevada and Arizona. Most abandoned cars have been removed from the countryside and auto dismantlers have a ready market for their stripped hulks; this was accomplished with no subsidy of any kind.

The closest shredder to Maryland currently in operation is in Philadelphia. It is owned by Pollock-Abrams Company and has a 200,000-ton-per-year processing capacity, which amounts to approximately 650 cars per working day. The process used by Pollock-Abrams is similar to that described above, except that there is no heating (or burning) of the scrap. Currently the plant attracts vehicles from a 60 mile radius, including the northern part of Maryland. Cars are brought in by auto wreckers who are paid $11 to $13 per car hulk, which is considerably higher than the average price paid by scrap processors using other methods.

Pollock-Abrams Company has a shredding facility planned for the Baltimore area. The planned capacity is the same as their Philadelphia operation—200,000 tons annually. On November 4, 1968, Mr. Abrams estimated that the Baltimore facility would be in operation in 8 months time—in July 1969. A second shredder, in Prince George's County, with a capacity of 25,000 vehicles annually is planned for installation by Joseph Smith and Sons, Inc., in Kenilworth, Maryland, a suburb of the District of Columbia. A third shredder, also with an annual capacity of 25,000 vehicles, is planned for installation by the Alexandria Scrap Corp., Alexandria, Virginia. These three shredders, together with the shredder currently in operation in Philadelphia, provide more than sufficient capacity to process both the current vehicle hulk inventory in Maryland, and all projected junked cars through 1979, and to process these hulks to meet the quality requirements of the steel industry.

In Maryland, therefore, the wider use of the shredding technique—now, merely a matter of time—will make processed automotive scrap acceptable in its entirety to the expanding scrap user market and will thus eliminate the accumulation of stripped junk auto carcasses.

The Disposal/Reclaiming Cycle—Solution to the Under-Utilized-Resource Problems. To relate these observations, then, to the seven problem areas identified in the first section of this report, the following results are anticipated: First, Problem 1—Vehicle abandoning continues at an increasing rate. *Solution:* The expected increase in the value of junked cars will result in little or no change in the number of vehicles abandoned, although more will be retrieved subsequent to abandonment as the value of the junked car rises. Therefore, government action, as indicated in the following section, is required to solve this problem. Second, Problem 2—There is a vast current inventory of abandoned vehicles which cover the countryside. *Solution:* The increasing demand for processed scrap and the development of shredders in Maryland will result in the retrieval of at lease some, and perhaps all, of the current inventory of abandoned vehicles. This forecast is based on the results achieved in other geographical regions subsequent to the initiation of shredding as the primary method of scrap processing. In these areas, including California, Missouri, Texas, Illinois, Pennsylvania, and Massachusetts, plants have attracted vehicles from as far as 500 miles. And new, more economical techniques of transporting junked cars have been developed to make these distances feasible; cars are flattened and

loaded 20 and more on large trucks. The value of auto hulks has risen markedly in the areas served by these shredders and hulks move readily into these plants rather than remain in auto wrecking yards, auto graveyards, or singly abandoned. Third, Problem 3—Currently, State laws and titling requirements unnecessarily restrict both the collection and disposal of abandoned and junked vehicles. *Solution:* Government action, as described later, is required to solve this problem.

Fourth, Problem 4a—The auto dismantlers' and scrap processors' facilities are not aesthetically acceptable. *Solution:* No improvement in this situation will result from the technical improvements in scrap processing or the increasing demand for processed scrap. Government action is required to solve this problem. Problem 4b—Air pollution is caused by the burning of vehicle hulks—a required preprocessing for the traditional methods of automotive scrap preparation. *Solution:* The shredding process will eliminate this problem and State legislation has already been passed which prohibits open burning.

Fifth, Problem 5—The current inventory of hulks, that is, vehicles stripped of saleable used parts, in auto dismantlers' yards is extensive. *Solution:* This inventory will be reduced upon the initiation of the shredding operations and will continue to be reduced as the demand for and quality of scrap improves. Sixth, Problem 6—The quality of scrap produced from auto hulks is often not acceptable to the steel and foundry industries. The traditional method of processing automotive scrap, that is; the compression of burned vehicle hulks into No. 2 bundles, often results in undesirable quantities of nonferrous materials remaining in the end product. *Solution:* This problem has been solved technically by the development of the scrap shredding process. And, in Maryland, sufficient shredding capacity to process all vehicle hulks will be available shortly. Seventh, Problem 7—The current methods of production used by the steel and foundry industries do not create sufficient demand for processed scrap to allow all automobile hulks to enter the scrap system. *Solution:* The increasing use of electric furnaces and the continuous casting process, both of which will create considerable additional demand for scrap, will result in the dissipation and disappearance of this problem.

In summary, then, the demand-related problems are expected to be solved due to the development of better scrap processing methods and an increase in the demand for scrap. On the other hand, the problems related to the junked car as a nuisance and an eyesore will only be solved by appropriate government action.

Recommended Government Action

The problems in the junked car cycle which require government action for solution are:

1. The abandoning of vehicles
2. The locating and collecting of abandoned vehicles
3. The restriction of vehicle collection and disposal resulting from extant State laws and titling requirements
4. The aesthetic and pollution problems created by auto dismantlers and scrap processors.

In order to assure solution of these problems, integrated government action is required to:

1. Stop vehicle abandoning
2. Require reporting of abandoned vehicles
3. Ensure proper disposal of worn-out or inoperable vehicles
4. Permit easier collection and disposal of vehicles
5. Solve aesthetic and pollution problems.

Stopping Vehicle Abandonment. The best method for halting the continuing flood of abandoned vehicles is the imposition of heavy penalties on those who

abandon them. A fine of up to $200.00, as was proposed in Senate Bill No. 16, is recommended. It is only by the legislation of such penalties that the impetus required to motivate vehicle owners to dispose properly of unwanted vehicles can be developed. In effect, such legislation will say to the vehicle owner that proper disposal of a vehicle is the least expensive method for ridding himself of it.

The traditional argument against this approach has been that the cost of finding the vehicle owner was excessive; and this is true since records were kept in such a way as to make quick retrieval of the required information difficult. However, the National Highway Safety Standards, issued June 27, 1967, require that the individual States establish an integrated Motor Vehicle Registration record system.

Specifically, Highway Safety Program Standard 4.4.2 requires that: Each State shall have a motor vehicle registration program, which shall provide for rapid identification of each vehicle and its owner; and shall make available pertinent data for accident research and safety program development.

I. The program shall be such that every vehicle operated on public highways is registered and the following information is readily available for each vehicle:

Make
Model year
Idetification number (rather than motor number)
Type of body
License plate number
Name of current owner
Current address of owner
Registered gross laden weight of every commercial vehicle.

II. Each program shall have a records system that provides at least the following services:

Rapid entry of new data into the records or data system

Controls to eliminate unnecessary or unreasonable delay in obtaining data

Rapid audio or visual response upon receipt at the records station of any priority request for status of vehicle possession authorization

Data available for statistical compilation as needed by authorized sources

Identification and ownership of vehicle sought for enforcement or other operation needs

III. This program shall be periodically evaluated by the State, and the National Highway Safety Bureau shall be provided with an evaluation summary.

With the availability of these records, the tracing of vehicle ownership will become significantly easier and the imposition of fines for vehicle abandonment could serve as a deterrent.

In Maryland, compliance with this standard is near completion. The requisite data has been collected and formated for computer input. The task yet remaining is the actual inputing of the data.

A second argument often proffered against such a policy is that those who abandon vehicles can least afford to be penalized (as a matter of fact, the expense involved in moving a junk car is frequently great). However, it must be remembered that with the development of shredders for processing scrap and the expected increase in the demand for this more technically acceptable scrap by mills and foundaries, the value of auto carcasses will increase and, if the experience in other locales is duplicated here, the demand for junk cars will be such that the owners of these vehicles will be able to dispose of them at little or no cost. Therefore, the effective date for legislation instituting penalties for vehicle abandonment should be held in abeyance until the shredding operations are open.

Reporting Abandoned Vehicles. Not only must the flow of vehicle abandonments be stopped, but also the extant inventory of abandoned vehicles must be located and collected. In order to assure that such vehicles are reported, an abandoned vehicle should be declared a public nuisance and its removel from public or private property to auto dismantlers and scrap processors required. In the event that vehicles on private property do not belong to the owner of that property, the property owner must have the resposibility for reporting the presence of such vehicles and requesting their removal by the police.

When the abandoned vehicle belongs to the property owner, responsibility for removing the vehicle or having it removed belongs to the owner. In all instances, the failure to report and/or dispose of a junked car should be a violation of law and result in a heavy fine (suggested $100.00).

In order that legislation could be effected to require the reporting and removal of motor vehicles, the following definition of an abandoned motor vehicle is recommended:

> "Abandoned Motor Vehicle" means a motor vehicle that is inoperable, is over 8 years old, and is left unattended on public property for more than 48 hours; or a *motor vehicle that is inoperable, is not validly licensed, and is left unattended on public or private property over 48 hours;* or a motor vehicle that has remained illegally on public property for a period of more than 48 hours; or a motor vehicle that has remained on private property without the consent of the owner or person in control of the property for more than 48 hours.

Under such a definition, a vehicle would be considered abandoned even if it were on the owner's property simply because it was inoperable and not validly licensed. It would be the responsibility of the vehicle owner therefore either to license the vehicle, to remove it, or have it removed.

An exception to such a provision should be provided for those who repair vehicles as hobbyists or who have a vehicle they are using for spare parts. It is recommended, therefore, that vehicles used for parts still be reported but that a 6-month exemption certificate be available to the owner of the vehicle upon his stipulation that the vehicle is being used as a source of parts or awaiting repair. In no instance should such exemptions be given for any more than two vehicles to any one individual.

The owner of property shall be liable to fine when any vehicle that fits the definition of abandoned, as provided above, is discovered by the police on his property unless he has reported the vehicle if he does not own the vehicle or unless he has obtained an exemption certificate if he does own the vehicle. It is further recommended that after discovery of such vehicles, the police provide a warning to the property owner, and require that he take action within seven (7) days or be fined.

Ensuring Proper Disposal of Junked Cars. The two recommendations made above, the legislation of penalties for abandoning vehicles and for failing to report or dispose of abandoned vehicles, are designed to force the proper disposal of motor vehicles. It is necessary, therefore, both to provide a proper method for vehicle disposal and to publicize it.

It is recommended that the following procedure for vehicle disposal be implemented: vehicle owners have the first responsibility to dispose of their unwanted vehicles; this disposal should be accomplished in one of two ways; either the vehicle owner shall contact an auto wrecker to have his vehicle taken away, or the vehicle owner shall take his vehicle to central collection points provided for the purpose of accepting worn-out vehicles. If

the vehicle owner is unable to take his unwanted vehicle to a free dumping area and has contacted an auto wrecker who has refused to accept his vehicle, the owner shall contact the police, who shall have the vehicle removed.

A central collection point or free dumping area should be provided by each county and incorporated municipality and its location well publicized. The costs to the political subdivision of identifying and locating abandoner would be saved in every instance in which the would;be abandoner brought in his own vehicle. Moreover, these areas would proivde a reasonable alternatiev to potential abandoners who would face a stiff penalty for vehicle abandonment.

In the event the vehicle owner can neither take his vehicle to a central collection point, nor contact an auto wrecker who will pick up his vehicle, the owner shall contact the police to have his vehicle removed. Upon request for vehicle removal, the police shall mail to the vehicle owner a form which will be completed and returned to the local police department. This form should include the make and model of vehicle to be collected, its location, its ownership (if known), and the name of the auto wrecker who was contacted and who refused to pick up the vehicle.

Upon receipt of the completed form, the police will pick up the vehicle using its own personnel, equipment, and facilities or will hire persons, equipment, and facilities for the purpose of collecting and storing these vehicles.

Laws and Titling Requirements. The imposition of penalties for abandoning vehicles and for failing to report and/or remove abandoned vehicles, together with the availability of central collection or free dumping yards for vehicle disposal and the design and publicizing of an approved and acceptable method for vehicle disposal will all help to expedite the flow of junked and abandoned vehicles back into the economic cycle.

Further legislation, however, is required to ensure ease of impounding and disposing of vehicles. Many low value abandoned and junked vehicles do not return to the economic cycle because of titling requirements or other provisions of State law which impose costly and time consuming requirements on motor vehicle sales and transfers. The problem is that these laws treat all motor vehicles as if they were of sufficient worth to warrant an owner to incur these costs. However, almost all abandoned and junked autos have a very low value. Since, basically, titling requirements are designed to protect an owner's interest in substantial property, and yet when that property is a motor vehicle it loses its substantial character, it is desirable that the state exclude, under carefully prescribed conditions, low value abandoned motor vehicles from the normal resale titling requirements. Some States have already taken legislative action in recognition of this need by passing statutes which, while continuing to protect the interests of vehicle owners, also allow public impounding and make a few exceptions to titling law. They have, thereby, provided a means for surer and more expeditious movement of junked and abandoned motor vehicles into the economic cycle.

Provisions to revise titling requirements were incorporated in Maryland Senate Bill No. 16, introduced January 17, 1968, and these provisions [sections (b) through (g)] were based on recommended legislation proposed by the Committee of State Officials on Suggested Legislation of the Council of State Governments. We recommend that these provisions of Senate Bill No. 16 be enacted as they were written with the possible exception of the requirement for sale of the vehicle at public auction; a potential change to this provision is discussed below.

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Solving Aesthetic and Pollution Problems. The aesthetic and pollution problems created by auto dismantlers and scrap processors can be solved either by the free action of these industries or by legislation which requires that, in order to continue in operation, firms in these industries meet specific criteria. Although certain actions have been initiated by industry toward solution of the aesthetic problem, particularly by beautification of facilities (the most successful of which has been Project Green/Screen sponsored by the Institute of Scrap Iron and Steel, Inc.), a drive along most of our major highways adjoining metropolitan areas clearly exhibits the scope of the problem as it still exists. In order, therefore, both to ensure compliance with the Highway Beautification Act and to remove these scars from our environment, it is recommended that the State adopt legislation requiring: licensing of all auto dismantlers and scrap processors; screening of all auto dismantlers' and scrap processors' facilities.

Licensing of these facilities would provide the State with a record of the population of firms engaged in these industries. Further, a prerequisite to obtaining a license should be the meeting of screening requirements.

The following screening provisions are recommended: all auto dismantlers' and scrap processors' facilities must be shielded or screened; such shielding or screening shall be accomplished only after approval of a shielding plan prepared by the facility owner and submitted to a responsible State, county, or municipal officer to be designated; the plans for shielding of each facility shall be presented to the responsible government representative within six months subsequent to the effective date of the enabling legislation; within six months of the approval of a shielding plan, the facility owner shall have completed the screening of his facility when he is using screening other than trees or shrubs; in the event he is using trees or shrubs, he shall complete his screening within six months of the date of approval of his plan, or as soon thereafter as the plants he has selected become available, in which instance a schedule must be determined and presented to the responsible government representative for approval.

In the event an auto dismantler or scrap processor fails to comply with these shielding requirements he should be subject to the loss of his license and a fine of not more than $1,000.00, or by imprisonment for not more than 5 years, or by both such fine and imprisonment.

In assessing the best methods for screening these facilities, we contacted; among others, the deputy director of the National Arboretum, and the Arnold Arboretum of Harvard University for advice regarding ornamentals to shield junked autos from the public view.

The Deputy Director of the National Arboretum recommended the *Cryptomeria japonica* (Empress tree). In this latitude the cryptomeria grows at the rate of approximately 5 to 6 feet a year. It is a very bushy, pine-like tree with short needles, but it absolutely shields things from view. A tree approximately 8 years old was about 40 ft high and about 10 to 12 ft in diameter at the base, while one approximately 15 years old was perhaps 60 or 70 ft high and about 20 ft in diameter at the base. The diameter refers to the diameter of the foliage. As anti-intrusion protection, in lieu of the chain link fence, he recommended the *Gerbers julianne* (Barberry). This particular barberry is very hardy and has sharp thorns approximately one and one half inches long. It grows into an impenetrable hedge. As an alternate, one might consider the *Poncirus trifoliata* (hardy orange). This bush also has thorns approximately an inch to an inch and one-half long, but the specimen we saw did not seem to be as effective a screen as the barberry.

An excerpt from *Arnoldra,* a publication of the Arnold Arboretum, Harvard

University, containing a further discussion of plants suitable for screening junkyards is presented in Appendix E.

The air pollution problem caused by the open burning of vehicles cannot be solved immediately, but can be abated. Until scrap shredders are installed and operating in the State of Maryland, it will be necessary for auto dismantlers and scrap processors to continue burning vehicles. We, therefore, recommend that interim controlled open burning be permitted *only* when the air is sufficiently unstable to ensure the dissipation of pollutants into the atmosphere.

Specifically, we recommend: that open burning of vehicles be permitted only after the passage of a cold front or if the lapse rate is at least a negative 3 degrees F per 1,000 ft of altitude; this meteorological condition will result in an adequate dispersal of pollutants; that a regulation to this effect be implemented by the State Department of Health; that the meteorologist in Environmental Health Services determine when open burning is permissible and have prime responsibility for informing the auto dismantlers and scrap processors of the times when they may burn; that the radio communications net currently used by the auto dismantlers for finding demanded replacement parts can be used for the rapid dissemination of the requisite meteorological reports.

We do not believe that the imposition of such a regulation will be harmful to these industries since: cold fronts pass through Maryland on an average of 3 to 4 days, and seldom more than 10 days apart, and conditions are such that burning could be permitted for 24 hours or more at each passage.

Police/Industry Cooperation. In Laws and Titling Requirements, above, we suggested that the requirement for sale of impounded vehicles at public auction might be dropped. This recommendation is based on the fact that it would be helpful if the police of the local political jurisdictions could develop agreements with the auto wreckers in their locale to pick up all abandoned and junked vehicles reported by the populace. These agreements would provide that the consenting auto wreckers would collect all vehicles of which they were informed by the police.

In return for providing this service, dealers who signed such agreements would be the only ones eligible to purchase any unclaimed vehicles impounded by the police. Further, all vehicles delivered to free dumping areas would be available to participating dealers. Those dealers who refused to sign such an agreement would not be eligible to purchase or collect any vehicles through the police or from the free dumping areas. In effect, exclusion from certain privileges would be based on noncooperation.

In order to permit the entering into such agreements by police and auto wreckers under the general police power, the public auction provision as stated in Senate Bill No. 16 would have to be dropped and the police given the power to invite only cooperating wreckers to vehicle auctions.

Contingency Considerations

We anticipate that the combination of industry activities and government actions discussed in Resource Utilization and Recommended Government Action, above, will result in the solution of the seven problems distinguished in the Disposal/Reclaiming Cycle. This solution is, of course, predicated on our forecasts of the future availability of scrap shredders and increasing demand for technically acceptable scrap resulting from the increased use of electric furnaces and the continuous casting process. We feel, therefore, that no action by the government exceeding those described above would be desirable.

If, in future years, government action is necessary in the actual collection and processing of junked cars or in the creation of demand for scrap, and any actions in these areas would be premature at this time or for the next few years, there are two basic alternative courses of action which government can follow: first, artificially supporting the demand for scrap by subsidizing the scrap industry, or second, entering into the dismantling and scrap processing industries to supplement the market sufficiently to clear it of unwanted junked vehicles.

Subsidizing Scrap. It has often been suggested that subsidies should be used to encourage the consumption of scrap. Subsidies should always be considered undesirable because of economic and administrative problems inherent in their use, and should be considered only as a last resort. As has been shown, the difficulties concerning the consumption of the unused auto hulks promises to be resolved in the near future, under a free market system, as a result of the expansion of shredding and increased demand for scrap. Therefore, it appears premature to consider subsidizing the scrap industry or its users at this point in time.

If, however, it becomes necessary to subsidize the industry in future years, and this decision can only be made after a review of the effect of shredding on the current situation, the optimal method for subsidization would appear to be the following: Impose a $10 charge on each new vehicle sold in the State to be paid by the vehicle purchaser; impose a $10 charge on each vehicle registering in the State from out of State; place these monies into an escrow fund; pay $10 from this fund to a scrap processor for each hulk purchased or accepted; limit the inventory a scrap processor may hold.

The imposition of a $10 charge on only new cars or cars entering the State results in less of a bookkeeping difficulty than would exist if an attempt were made to impose such a fee on all registered vehicles. Since the number of vehicles leaving service annually is substantially less than the combined number of new cars sold in the State plus vehicles entering the State, the fees received would be more than adequate to cover expenses, including those for administering such a program, and residual funds could be applied to deficits incurred in the collection of abandoned vehicles.

The payment of this subsidy or "bonus" would serve to clear the economy of junked vehicles since: the subsidy would reduce scrap processors costs substantially; some of this cost saving would be passed to scrap users since only by a lowering of prices would demand be increased enough to reduce processors inventories and allow the scrap processor to receive more vehicles and thereby collect further subsidization and increase his profits; a further portion of this subsidy would be passed back to the junk dealer since the hulks would be worth more to the scrap processor than formerly; the junk dealers would accept junked cars more readily since their value to him would increase as the value of the hulk increased; more abandoned vehicles from a wider radius would be recovered due to their increase in value; the temptation to abandon vehicles would be reduced as the value of the vehicle was increased.

However, no such action is recommended at the current time.

Junkyards of Last Resort. A second approach, and, if accumulating metallic solid wastes becomes an acute problem, we believe a more advisable approach would be the establishment of "junkyards of last resort." These facilities would be government owned and operated and their primary purpose would be to supplement the existing dismantling and processing industries in order to clear the economy of unwanted vehicle hulks and other metallic solid wastes.

We believe the establishment of these facilities is preferable to subsidization of industry in the unlikely event that either will be required. The most pertinent reasons for favoring this method of absorbing undemanded junked vehicles into the economic flow are: the difficulties mentioned above with the administration of subsidies; the danger inherent in providing a method whereby an industry will be supported if it fails to operate in a desirable manner; the potential and likely reaction of industry to the possibility of being supported in the event that they do not solve this problem would be to continue operation at current levels in anticipation of future government support; if this occurs, then the suggestion of *possible* future action (subsidizing) will result in the later necessity of government subsidization; such facilities could provide a place of employment for handicapped persons, school dropouts, and job corps personnel, and thereby provide a desirable social service.

Government facilities required to provide this service would be: scrap shredding facilities with sufficient capacity to process residual balances of metallic solid wastes remaining after private industry processing; auto dismantling and parts storage facilities in each county; portable vehicle flatteners and flat bed trucks for transport of vehicle hulks to shredder(s).

A preliminary attempt was made to describe more specifically the size and location of the requisite facilities; however, since we feel that the ramifications of the recent technological developments in the steelmaking and scrap processing industries are going to be extensive, design criteria and cost analyses for needed facilities made at this time would be no more than guesses. Prior to any such detailed analysis, it will be necessary to assess the results of scrap shredding and an adequate analysis will require the operation of such facilities for, we feel, a minimum of two years. Only then will it be possible to assess the magnitude of any residual problems.

Level of and Responsibility for Action

The following paragraphs are designed to serve as a brief review of the problems and the conclusions we have reached and to indicate the level of government which would have responsibility for action with the enactment of legislation incorporating the above recommendations.

The Abandoning of Vehicles. We have recommended the imposition of heavy fines for vehicle abandonment. Legislation is required at the State level to make such penalties Statewide and effective. We are in agreement with the provisions of Senate Bill No. 16 regarding these penalties. Enforcement of antiabandonment provisions would be accomplished by local police and courts using records available from the State Department of Motor Vehicles.

Reporting Abandoned Vehicles. We have recommended that an abandoned vehicle be defined by law as a public nuisance and the reporting and/or removal of such vehicles be required, with penalties for noncompliance. Such a provision should be incorporated in the same legislation as the antiabandoning provision outlined above.

Ensuring Proper Disposal of Junked Cars. Free dumping areas cannot be legislated and the establishment, therefore, of such facilities is a responsibility of local political jurisdictions. Incorporated in the same legislation as the antiabandoning and reporting provisions recommended above should be a requirement that vehicle owners contact at least one auto wrecker before requesting removal of a vehicle by police.

Laws and Titling Requirements. We recommend that the provisions contained in sections (b) through (g) of Senate Bill No. 16 be enacted as written with the ex-

ception of the requirement for the sale of vehicles at public auction. In place of this provision we recommend that the police departments of local political jurisdictions be permitted to dispose of vehicles as they wish.

Solving Aesthetic and Pollution Problems. We recommend that separate legislation be written requiring the licensing of auto dismantlers and scrap processors and that as a prerequisite to operating such facilities a screening requirement be imposed, to include: a 6-month period after the effective date during which plans for screening must be developed and presented; a 6 month period thereafter during which screening must be accomplished; a requirement that all future facilities meet screening requirements prior to licensing; no legislation concerning pollution is required since laws currently on the books appear adequate. We do recommend, however, the regulation of open burning to meet the following stipulations: burning be permitted only after the passage of a cold front or if the lapse rate is at least a negative 3 degrees F per 1,000 ft altitude; the meteorologist in Environmental Health Services be responsible for determining when such burning is allowable; that a regulation to this effect be developed by the State Department of Health.

The Systems—Current and Projected: An Integrated Overview

This study began with a description of the junked car, what happened to it, and the problems that resulted from a systems approach. That is, we defined the boundaries or limits of our system to include the flow of the vehicle from its ceasing to be useful as a mode of transportation until the salvable materials it contained were used (or could be used) by the industries for which they were raw materials. We then defined the components of this system and the problems in its current operation. Each component and problem was analyzed, conclusions were drawn, and recommendations were made to provide a solution to these problems. In previous sections, the problems, conclusions, and recommendations have been considered individually. This section is composed of a systhesis of our conclusions and recommendations to estimate their integrated effect on the operation of the junked car disposal/reclaiming cycle. Four flow charts are presented: A1 (Exhibit V)—a modified decision logic flow chart of activities comprising the disposal and collection of junked vehicles as they currently occur; A2 (Exhibit VI)—a modified decision logic flow chart of the operations of vehicle dismantlers and scrap processors as they currently occur; B1 (Exhibit VII)—a modified decision logic flow chart of the activities comprising the disposal and collection of junked vehicles as they will occur incorporating our conclusions and recommendations; B2 (Exhibit VIII)—a modified decision logic flow chart of the operations of vehicle dismantlers and scrap processors as they will occur incorporating our recommendations and conclusions.

The flow charts have been delimited to include those activities and decisions which are related to the problems as they currently exist.

On both pairs of flow charts (A1 and A2 describing the extant situation, and B1 and B1 and B2 depicting the anticipated results of the recommended actions), 15 points in the flow have been designated by circled numbers; these points are the same on each pair of charts and are discussed briefly below.

These have been selected to delineate, statically, points in the flow where significant changes are anticipated contingent upon implementation of our recommendations.

We will first discuss, briefly, the 15 selected in flow charts A1 and A2—the current situation. We will then analyze the same 15 points in the flow after

implementation of the proposed recommendations. Finally, we will discuss one of our conclusions in the dynamic situation, in other words, we will trace the effect of a single change through the entire flow to describe the effect of this change on all parts of the system.

The Current Situation. The following 15 paragraphs relate to the 15 symbols in flow charts A1 and A2 (Exhibits V and VI) accompanied by the circled numbers 1 through 15.

① Know Proper Disposal Method?
As indicated earlier in this report, one of the prime causes of vehicle abandonment is the ignorance of vehicle owners regarding the proper methods of vehicle disposal.

② Cost of Proper Disposal Excessive?
A vehicle owner is likely to consider any costs which he incurs in disposing of a vehicle to be excessive; these costs include money expended, inconvenience, time lost. In such an atmosphere, vehicle abandonment is flourishing and will continue to do so.

③ Junked Car on Owner's Property
Since the owner did not properly dispose of the vehicle and since the police cannot retrieve such vehicles, these vehicles remain abandoned.

④ Junked Car on Other Private Property
If the property owner complains to police about vehicle(s) abandoned on his property, they are retrieved. However, from the accumulation of junked cars on private property, especially farmlands and other areas of low-population density, it is apparent that frequently no such complaints are forthcoming.

⑤ Junked Cars on Public Property
Vehicles abandoned on public property are retrieved by police or their agents after discovery or complaint. Most vehicle retrievals are currently from public property.

⑥ Collection of Vehicles by Police
Conditions under, and methods by, which vehicles are retrieved vary greatly, and the cost to citizens is high.

⑦ Trace Vehicle Ownership
A manual system of ownership record-keeping makes information retrieval a slow and tedious process.

⑧ Sale of Impounded Vehicles at Auction
Such sales are the rule and tend to reduce the number of vehicles that would be retrieved by wreckers since the vehicles are here available already collected at a central point and, therefore, transportation costs can be reduced.

⑨ Junk Dealer Accept Junked Car?
Frequently, due primarily to the low value of vehicle hulks, auto dismantlers refuse to pick up or purchase junked cars.

⑩ Junkyard Inventories
Inventories of junk vehicles are unsightly and junk yards are normally located adjacent to transportation routes and open to public scrutiny.

⑪ Demand for Hulks?
The demand for stripped hulks is a function of the demand for processed scrap. Lack of demand results in stripped hulks remaining in junkyard inventories.

⑫ Burning of Vehicles Required?
Current methods of scrap processing require that vehicle hulks be cleaned by burning.

⑬ Scrapyard Inventory
The functions performed by scrap processors result in their facilities being unsightly when not adequately screened.

⑭ Demand for Processed Scrap?
When demand for processed scrap is insufficient, vehicle hulks remain in scrapyard inventories and purchases from auto dismantlers and others are reduced.

⑮ Accepted by User?
When processed scrap is technically unacceptable to scrap users, either the users do not purchase it, or they refuse to accept shipments which fail to meet quality specifications.

The Projected Situation. The following 15 paragraphs relate to the 15 symbols in flow charts B1 and B2 accompanied by the circled numbers 1 through 15, and the

hexagonal figures, indicating conclusions and recommendations, related to each.

① Know Proper Disposal Method?

Publicity of proposed method for proper vehicle disposal combined with fines for vehicle abandonment would eliminate this cause of vehicle abandonment.

② Cost of Disposal Excessive?

The imposition of heavy fines for vehicle disposal, together with the provision of free vehicle dumping areas as an alternative means of disposing of vehicles, would ensure that improper disposal (abandonment) of a vehicle is the highest cost alternative open to vehicle owners, thereby making abandonment the excessive cost alternative.

③ Junked Car on Vehicle Owner's Property

The definition of an abandoned auto as a public nuisance and the requirement to report and/or dispose of these vehicles or face heavy penalties would ensure the return of these vehicles to the economic flow.

④ Vehicle Abandoned on Other Private Property

The definition of an abandoned vehicle as a public nuisance and the requirement that such vehicles be reported by property owners would ensure that abandoned vehicles would be located and could be collected. The number of vehicles abandoned on private property would decline significantly with the imposition of heavy fines for abandonment.

⑤ Vehicles Abandoned on Public Property

The imposition of heavy fines for vehicle abandonments will significantly reduce the number of vehicles abandoned on public property.

⑥ Vehicle Retrieval by Police or Agent

The development of Police/Industry Agreements together with the increasing value off junked vehicles due to improved scrap processing techniques and increasing demand for processed scrap will result in the retrieval of a larger percentage of a reduced number of abandoned vehicles.

⑦ Trace Vehicle Ownership

The imposition of fines for abandonment will reduce the number of vehicle abandonments. The implementation of Federal Highway Safety Standard 4.4.2 will provide an integrated and accessible information retrieval system for tracing vehicle ownership, and reduced titling requirements will permit earlier disposal of vehicles.

⑧ Sale of Impounded Vehicles

Reduced titling requirements will ensure greater ease of vehicle disposal and the implementation of police/industry agreements, together with the increasing value of junked vehicles, will result in higher values of impounded vehicles and less vehicles which will require impounding.

⑨ Junk Dealer Accept?

The combination of the increasing value of junked vehicles and police/industry agreements will ensure the flow of junked vehicles back into the economic cycle.

⑩ Junk Vehicle Inventory

Screening requirements would hide unsightly collections of junked cars from public view and the increasing demand for scrap will result in a reduction of the junked car inventory.

⑪ Demand for Hulks?

The combir.ation of increased quality scrap produced by the shredding method and the exxpanding use of electric furnaces and the continuous casting process will result in an expanding demand for vehicle hulks by scrap processing.

⑫ Require Burning?

Shredding vehicle hulks eliminates the necessity of burning the hulks as a necessary scrap preprocessing step.

⑬ Scrap Yard Inventory

As with junk yards, the scrap processor's facility will be hidden from public view by requiring the screening or shielding of such facilities.

⑭ Demand for Processed Scrap?

The demand for processed scrap will increase due to: better quality processed scrap produced by the shredding method;

increased use of electric furnaces in steel and casting production; expanding use of the continuous casting process by the steel industry.

⑮ Scrap Acceptable to Users?
The shredding process creates processed scrap technically superior to that produced by other methods and ensures that this scrap meetes user requirements.

Each of the 15 points of difficulty indicated in Charts A1 and A2, which depict the current situation, will, as has been shown, be favorably effected by the implementation of the conclusions and recommendations presented herein.

Finally, we wish to present dynamically the interrelationships between all problem areas and all conclusions and recommendations.

Dynamic Relationships. A matrix of problems and the recommendations and conclusions relating to each is presented as Exhibit IX. The interrelationships which will be affected by the conclusions drawn and recommendations made are indicated by X's. Note that all components of the matrix relate either directly or indirectly to all other components. For example, reviewing Problem 2 as shown in Exhibit IX, Excessive Cost of Disposal, it is clear that a number of matrix elements affect the cost of disposal: The development of a proper method of disposal to inform the populace of how to rid themselves of an unwanted vehicle—ignorance of the alternatives open to a vehicle owner can and does lead to the selection of improper or costly vehicle disposal alternatives. The provision of free vehicle dumping areas provides an alternative to abandonment, costly to the taxpayer, and to other forms of disposal. The establishment of a fine to penalize vehicle abandoners assigns a high cost to abandonment and makes proper disposal a lesser cost and, therefore, a desirable alternative. The definition of an abandoned vehicle as a public nuisance and the establishment of heavy penalties for improper disposal makes the abandonment of a vehicle on one's own property a costly alternative, and, therefore, makes proper disposal a comparatively lesser cost alternative. Police/Industry Agreements provide both a method whereby more vehicles can be collected for less cost and, in effect, a central information clearinghouse for vehicle locations. Integrated, and automated, Department of Motor Vehicle records provide a basis for quicker and more accurate checks of titling records, faster location of owners of abandoned vehicles, and easier title clearance; these factors combine to reduce the cost of locating abandoners and reduce the time and costs incurred when holding impounded vehicles. The increasing demand for scrap resulting from the expanding use of both electric furnaces and continuous casting and from the higher quality of shredded scrap results in a higher price for processed scrap due to an upward shift in the demand curve which leads to a higher value for junked cars since the hulks have an increased value. This in turn will result in more junked cars being collected and/or bought by junk dealers, thereby reducing the number of potentially abandoned vehicles or, stated differently, providing a more attractive least cost alternative for vehicle disposal. Thus we can see that the problem of excessive costs is diminished considerably by the interaction of numerous conclusions and recommendations.

The same kind of analysis can be performed for each horizontal and vertical column of the matrix and was performed during the completion of this study.

Problems \ Conclusions/Recommendations	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.	L.	M.	N.	O.	P.
1. Know Proper Disposal Methods?	X	X	X	X				X								
2. Cost of Disposal Excessive	X	X	X	X	X		X		X	X	X					
3. Vehicle Abandoned on Owner's Property	X	X		X	X											
4. Vehicle Abandoned on Other Private Property	X	X	X	X	X		X	X								
5. Vehicle Abandoned on Public Property	X	X	X		X		X	X								
6. Vehicle Collection	X	X	X	X	X						X					
7. Trace Vehicle Ownership							X	X								
8. Sale of Impounded Vehicles	X	X			X		X	X			X					
9. Junk Dealer Accept?			X	X	X			X	X		X					
10. Junk Yard Inventory						X			X		X					
11. Demand for Stripped Hulks?									X	X	X					
12. Burning Required?													X	X		
13. Scrap Yard Inventory						X			X	X		X		X	X	X
14. Demand for Processed Scrap														X	X	X
15. Scrap Acceptable to Users									X			X		X	X	X

Legend

A. Develop Proper Disposal Method
B. Free Dumping Areas
C. Fine for Abandoning
D. Public Nuisance
E. Police/Industry Agreements
F. Screening Requirements
G. Integrated DMV Records
H. Reduced Titling Requirements
I. Increasing Scrap Demand
J. Higher Dollar Value of Scrap
K. Higher Dollar Value of Hulks
L. Better Quality Scrap
M. Interim Controlled Burning
N. Shredding Process
O. Increasing Continuous Casting
P. Increasing Electric Furnaces

EXHIBIT IX. *Matrix of Problems/Conclusions/Recommendations.*

Appendix A. County Data

The information presented in this Appendix was obtained primarily from county officials and county land use plans. Where data was obtained from other sources, that source is indicated.

Allegany County

Allegany County has six dumps and two landfill disposal sites, the latter of which are sanitary landfills. These are run cooperatively by the City of Cumberland, the County and State Health Department. These landfills are worked-out strip mine sites. All disposal operations, public and private, must use approved sanitary landfill or incinerator methods of disposal.

There are 16 licensed junk yard operators of significant size in the county. Half of these are near the Pennsylvania and West Virginia lines. There are also some small part-time operators who salvage from five to ten automobiles per month. The total county inventory of junked vehicles is approximately 6,500 vehicles. The Allegany County Comprehensive Master Plan (1965) specifically treats automobile graveyards and auto wrecking yards. The Plan proposes to control automobile graveyards. There are regulations pertaining to auto graveyards and junk yards in the new County Zoning Ordinance: the yards must be out of public sight and enclosed or screened. It is also suggested that they be limited to the industrial districts. The majority of the county, which is zoned agricultural, can be used for auto wrecking yards with special approval.

There are an estimated 150 cars per year abandoned in Allegany County.

Anne Arundel County

There are nine refuse disposal sites in the county—two are city sanitary landfills (Annapolis), and seven are private dumps. There are nineteen large junk yards and approximately a hundred smaller junk yards (averaging four or five vehicles each) containing a total county junk yard inventory of 3,000 vehicles. There are an estimated 25 to 50 abandonments per year.

Anne Arundel County held a public hearing on a proposed bill on Junk and Salvage Yards on Monday, October 7, 1968. The Bill deals with licensing, location requirements, operation, enforcement, and allowable exceptions to these provisions.

Baltimore City

There are two privately operated dumps and two city operated sanitary landfills. There are 36 licensed junk yards in Baltimore, and 2,800 to 3,000 abandoned automobiles are handled annually by the Police Department. Abandonments are increasing at about 10 percent per year. These vehicles are estimated to be only 40 percent of the total abandonment.

The present impounding yard is 2.4 acres and is severely overtaxed. One cause for the congestion is the necessity for keeping the cars until the titles clear. A new yard of 15–20 acres is scheduled to be put in use shortly.

Last summer an antiburning ordinance was put into effect in the city. This will affect the junk yards operations adversely, since local scrap processors currently require burned vehicle hulks.

Baltimore County

Baltimore County has four county sites which are sanitary landfills. There are 32 vehicle junk yards by count, although it is estimated that there are 50 or more. There are 36,640 vehicles in junk yards by count; it is estimated that there are actually 50,000 to 60,000.

Police department records show 410 cars abandoned from July 1, 1967 to June 1, 1968.

Calvert County

Calvert County leases land for four dumps. Maintenance of these dumps is provided on a contract basis with the property owner. There are no solid waste dumps and no junk yards as such in the county. Garages, auto agencies, etc., make arrangements for junk vehicle disposal. There are four yards operated as junk yards which include an estimated total of 400 cars.

The estimated abandonment rate is 20 cars per year.

Caroline County

There is one sanitary landfill in the planning stage and four existing public dumps. Twelve junk yards of a total of 15 or 16 are licensed. There is a total inventory of approximately 1,000 vehicles in these junk yards.

There was a recent public hearing on a junk ordinance which had an effective date of October 1. This ordinance required screening of junk yards within 6 months of the effective date.

The annual abandonment rate is estimated at 100 vehicles.

Carroll County

There are three city dumps and four county sanitary landfills in Carroll County. There are 31 vehicle junk yards with an inventory of approximately 45,000 vehicles. It is estimated that about 800 vehicles are abandoned annually in the county. Many abandoned cars away from the highways have been observed from the air.

Cecil County

There are three city dumps and four county dumps in Cecil County. These are fairly evenly spread throughout the county.

There are 24 junk yards holding 2,540 vehicles in the county. These are primarily in the northern half of the county.

There are an estimated 1,000 cars abandoned in the county per year.

Charles County

There is one county dump in Charles County.

There are four large and 20 small junk yards in the county, whose inventory totals 4,000 junk automobiles. The County Comprehensive Plan notes a "widespread incidence of junked and abandoned cars throughout the county." There are an estimated 1,000 cars per year abandoned in Charles County. Many of these abandoned cars are from Washington, D.C.

Dorchester County

There is an estimated total of six city and two county dumps. The county does not own dumps but maintains them. The dumps are fairly well distributed in the county.

There is one licensed junk dealer in the county. There are also about 10 junk yards holding 25 or more cars and 20 to 25 smaller yards holding 15 cars or fewer. The junk yards are fairly well spread throughout the county. Estimates of county inventory of junked cars vary from 700 to 3,000 vehicles. Estimates of number of vehicles abandoned annually vary from 100 to 600.

The county's *Report on Refuse Collection and Disposal* cites abandoned cars as an increasing problem. It also discounts

the use of landfills as depositories for the vehicles and it recommends an interim measure of storing vehicles at future landfill sites to await further handling and disposal. The report also recommends intercounty and possible interstate cooperation in this area. According to this report, handling of abandoned vehicles "has become a burden of the government."

Frederick County

Frederick County has two city dumps (one of which is under litigation by opponents) and one county dump. There are also at least six private dumps—two of which are inside the Frederick city limits—engaged in open burning. There are thirteen vehicle junk yards holding 25 junk autos or more with a total county inventory of 7,055 junk vehicles. 250 vehicles are abandoned annually.

Garrett County

There are four dumps under county control and operated at county expense. There are old auto bodies in one dump near Oakland. There are six municipal dumps, one of which uses open burning. It is planned to use abandoned strip mines as landfills in two municipalities. There are two private dumps in the county. Additional county sanitary landfills are planned.

There is no zoning in the county. A junk yard ordinance exists, but it is difficult to enforce. There are three or four operating junk yards and a minimum of ten auto graveyards containing 2,000 junked autos, plus at least 1,000 vehicles scattered throughout the county.

The estimated annual abandonment is 100 to 200 cars.

Harford County

Harford County has three city dumps and seven county dumps. These are distributed throughout the county. There are 19 junk yards and the junk yards' inventory is 15,000 vehicles. There are an estimated 3,000 vehicles abandoned annually.

Most of the junk yards are along Route 40 in the southern part of the county.

Howard County

There are two county landfills in Howard County and ten vehicle junk yards with a total inventory of 750 vehicles. Seventy-five vehicles are abandoned in the county per year. The Howard County General Plan recommends the initiation of rehabilitation program areas along Route 1. The junk yards are in the vicinity of the major routes through the county, i.e., Routes 1 and 40.

Kent County

There are five county dumps and one city dump in Kent County, and one vehicle junk yard in the center of Chestertown. No estimate of annual vehicle abandonment was available.

Montgomery County

There is one county site in Montgomery County including an incinerator and a sanitary land fill. There are three junk yards located near the center of the county. The total county inventory of junk cars is estimated at 800. The annual abandonment estimate for the county is 1,800 cars.

Prince Georges County

There are two city and two county dumps and four city operated sanitary landfills in Prince Georges County. The dumps are located principally in the northern part of the county. Potential sanitary landfill sites are adequate for future development according to a Solid Waste Disposal Study.

There is an estimated minimum of 100 junk yards in the county—spread throughout the county, although generally away from Washington. An auto wrecker estimates that there are 25,000 cars in junk

yards in the county. The Department of Licenses and Permits estimated 6,000 cars are abandoned every year.

Queen Anne's

There are six county dumps dispersed throughout the county.

The county's Comprehensive Master Plan shows a total of 14 auto graveyards and junk yards. Telephone conversations with county personnel yielded a figure of six junk yards plus a number, perhaps 50, of service stations which serve as junk yards. The Master Plan notes that the auto graveyards "are scattered generally through the county, but mostly along the railroad lines or main highways." The Plan allows zoning "General Industry Areas" for such industries as junk and scrap in several places throughout the county. There are 2,420 acres proposed to be zoned for this purpose.

St. Mary's County

There are 11 county dumps in St. Mary's County, and 200 acres of deep ravines used for dumping cars; these are not entirely satisfactory, as they provide breeding areas for snakes, rodents, and insects.

There are 21 vehicle junk yards in the county—owned by garages—with an estimated 1,000 to 1,500 junked car inventory. There are many complaints about the junk yards. Some have vehicles piled three high, creating an eyesore and a hazard.

There are 500 cars abandoned per year in the county.

Somerset County

Somerset County has one city dump and six county dumps.

There are 13 vehicle junk yards with 20 or more autos. The estimated total county inventory of vehicles in junk yards is 3,000.

An estimated 200 cars are abandoned per year in Somerset County.

Talbot County

Talbot County has three dumps on record. The City of Easton operates a sanitary landfill and accepts refuse from adjoining county areas.

There are four vehicle junk yards on record with a record inventory of 500 vehicles.

The official count for annual abandonment of vehicles is 100, although one estimator suggested 200 was closer to an accurate figure.

Washington County

There are seven city sites, mostly landfills, and three county dumps in Washington County. Information on these dumps is included in a report entitled *Refuse Collection and Disposal in Washington County, Maryland.*

The junk yard inventory is 4,890 cars. This information comes from a report which was the result of a class project of the Conservation of National Resources Class of the Hagerstown Junior College in 1968.

This report gives the following information: There is a major scrap processor (Maryland Pipe and Metal) in Hagerstown. It has a shear that can process 110 to 125 burned cars a day. Since open burning is now illegal, the company is considering building an incinerator. The firm tries to stockpile vehicles, as supply rate is uneven, and draws junked cars from a 50-mile radius.

There are good markets:

- Motor blocks go to foundaries in Pennsylvania
- Copper goes to Middle Atlantic state refineries
- No. 2 bundled scrap goes to steel mills in Baltimore and Pittsburgh or are exported through the port of Baltimore

Autos come to Hagerstown from West Virginia, Pennsylvania, and Virginia.

There is continuing buildup of single abandoned cars and multi-car concentrations on private property.

A junk dealer in Hagerstown estimated that the annual abandonment rate in the county was 350–400 cars. A recent city police survey in Hagerstown showed 200 vehicles in alleys, on corner lots, etc.

Wicomico County

There are two city sites, including an incinerator and eight county dumps in the county.

There are six junk yards—mostly in the eastern part of the county. The total county junk yard inventory is approximately 1,800 cars.

An estimated 100 cars are abandoned annually in Wicomico County.

Worcester County

Worcester County has three city and five county dumps.

There are five vehicle junk yards with an estimated total inventory of 1,500 junked cars.

The Comprehensive Master Plan includes suggestions for a comprehensive zoning ordinance which will control or eliminate automobile graveyards. There are 49 acres devoted to auto graveyards and junk yards in the county.

Five hundred cars are abandoned each year in Worcester County.

Appendix B. Cars Entering the Scrap Cycle

Before analyzing the alternative solutions to the problems created by the increasing number of junked cars introduced into the scrap cycle annually, a data base (consisting of actual and estimated numbers of junked cars in the Nation, Maryland, and its political subdivisions) was collected. Using these data, a statistical model was developed which correlated well with historical scrappage of vehicles. This model was based on the sales of vehicles in previous years.

To forecast the future number of vehicles entering the scrap cycle, the sales of vehicles in Maryland and its political subdivisions were forecast; using this data, the predictive model was applied, resulting in a projection of future junked cars in the State.

Statistical Model for Predicting Number of Cars Entering the Scrap Cycle Annually

The authors (MTI) developed a mathematical predictive model that very closely predicts the number of scrap automobiles nationally, in the State of Maryland, and, with somewhat less accuracy, for each separate county in the State of Maryland. It appears that the predictive method developed may be highly useful to scrap dealers who are considering making capital investments in such items as shredders and other disposal equipment.

While the statistical methods used are relatively simple, the important fact is that the method used appears to provide useful answers. The statistical methods

are discussed in some detail in this presentation; however, a simplified method of using these statistics is also presented. The simplified method requires only that the user determine the number of new cars registered in the jurisdiction in the geographical area in question over the past 15 to 20 years. Each of these numbers is then multiplied by a factor that is tabulated, and the results are summed to give the best prediction for the number of cars to enter the scrap cycle in that geographic area during the following years.

MTI gratefully acknowledges the assistance of Mr. Wilfred H. Shields, Jr., many other officials of the State of Maryland, the Institute of Scrap Iron and Steel, the National Automobile Manufacturers Association, and other persons who were kind enough to assist in providing data for this study.

The Problem. The problem consists of finding a method of predicting, for any given year, the number of automobiles likely to be scrapped during that year. There were many data available that one might consider could be used to make such a prediction. These data were as follows: (1) The number of cars entering the scrap cycle annually (available from the *American Automobile Manufacturers Association).* (2) The number of factory car sales (available from the *American Automobile Manufacturers Association).* (3) The number of automobiles exported per year and the number imported per year (available from the *U.S. Department of Commerce).* (4) The number of automobiles registered in the State of Maryland for each year (available from the *Department of Motor Vehicles, State of Maryland).* (5) The number of new cars sold in the State of Maryland per year (available from the *Maryland Automobile Dealers Association).* (6) The number of new automobiles sold in each county per year (available from the *Maryland Automobile Dealers Association).* (7) The number of cars registered in each county per year (available from the *Department of Motor Vehicles, State of Maryland).*

No data were available from the *Auto Dismantlers of the State of Maryland* regarding the number of cars actually entering the scrap cycle annually.

Other factors that we thought might influence the scrap cycle included the effect of production slowdown during World War II, variations in the economic cycle, number of used cars imported into a State, automobile taxation policy, the value of scrap, and other variables that might influence individuals either to dispose of cars prematurely or to retain them for an abnormally long period.

Technical Approach. Before attempting a multivariant analysis involving all of the possible influences on the number of cars entering the scrap cycle annually, we decided to determine if simple methods could provide estimates accurate to better than 5 or 10 percent; as we believed that such accuracy would be sufficient. To determine whether a simple analysis might provide meaningful data to the above accuracy, we did the following.

We hypothesized a probability density function of the survival of new automobiles:

$$f(t) = \frac{2}{\pi y} e^{-\frac{\pi}{y^2}}$$

$$o \leq t \leq +\infty$$

where:

y = mean life in years

t = time in years since manufacture.

It is to be noted that this expression has the same form as the normal probability function, and it is a convenient approximation since the normal function is tabulated.

Using data consisting of the number of new cars introduced into the United States each year, and operating on these numbers by the assumed standard distribution, we listed the probable number of cars produced in any given year that might be

scrapped in any other year. We did this for several distributions—using values for y of 6.4, 7.6 and 8 years.

We determined the number of cars that were predicted to be scrapped year-by-year based *solely* on the number of new cars produced during *previous* years.

We compared the predictive results for the three values y (mean life) with the number of cars actually entering the scrap cycle.

The result on a nationwide basis encouraged us to apply the same method to the State of Maryland. Here a difficulty arose because data were not available from any source regarding the actual number of cars scrapped in any given year. To determine the best estimate of the number of cars actually scrapped in any given year, we took the number of cars registered during the previous year, added this number to the number of new cars registered during the year in question, and subtracted from this sum the number of cars registered during the given year. This determination is, of course, not strictly accurate, as it makes the tacit assumption that operating used cars do not enter or leave the State.

We then compared the calculated number of vehicles scrapped by year with the number predicted by our statistical formulation. The results were sufficiently encouraging to cause us to follow the same procedure in three representative counties of Maryland. To facilitate calculations of the fraction of cars produced in a given year that would be scrapped in another year, we used the following formulation:

$$P_i = \frac{2}{\pi y} \int_{i-1}^{i} e^{-\frac{t^2}{\pi y^2}} dt$$

where:

P = the probability of a car lasting exactly i years

t = time in years since manufacture

y = mean life in years.

Using nationwide data, a computer program was written to determine the number of cars scrapped in the last 10 scrap years for y equal to 7.2, 7.6, and 8 years. It was found that a mean life (y) of 8 years yielded the best fit to the actual scrappage data on a nationwide basis for the past 10 scrap years.

However, a mean life of 7.6 years provides a much better fit for the past 5 scrap years. The data seem to be suggesting that people in recent times tend to retain their automobile for, perhaps, half a year less than they did a decade ago.

Three technical points about our formulation might be argued: (1) The choice of the distribution. It might well be argued that another distribution would be more appropriate, and, indeed, another distribution could be determined directly by using the following formulation:

$$S_N = \sum_{i=1}^{i=N} P_{(N-i)} M_i$$

where:

$P_{(N-i)}$ = the probability of a car lasting exactly N minus i years

M_i = the number of cars manufactured in the year i.

We know S_N and M_i for some 23 years. Therefore, we could form a set of 23 simultaneous linear equations and solve for the $P_{(N-i)}$. In the alternate, we would make the reasonable assumption that no car enters the scrap cycle beyond an age of 20 years, form three different sets of 20 simultaneous linear equations, and solve for P's using what would then amount essentially to three different sets of data. We did not do so because it is apparent that World War II had a major effect on the scrap cycle of automobiles, and we believe that only inthe present decade has the effect of World War II, and, possibly the Korean War, ceased to have significant effects on the number of cars scrapped. In other words, we are interested in recent history as opposed to ancient history—which was

TABLE 1

NATIONWIDE SCRAPPAGE FIGURES—ACTUAL VERSUS PREDICTED

Scrap year	Actual no. scrapped	Predicted number scrapped					
		$y=7.2$	Difference	$y=7.6$	Difference	$y=8$	Difference
1957	3,700,000	4,065,591	−365,591	3,923,291	−223,291	3,663,792	+36,208
1958	3,600,000	4,381,959	−781,959	4,238,788	−638,788	3,952,650	−352,650
1959	4,600,000	4,517,438	+82,562	4,383,504	+216,496	4,082,545	+517,455
1960	4,200,000	4,761,155	−561,155	4,635,061	−435,061	4,303,860	−103,860
1961	4,400,000	5,050,895	−650,895	4,931,748	−531,748	4,579,541	−179,541
1962	4,700,000	5,209,577	−509,577	5,098,936	−398,936	4,731,304	−31,304
1963	5,300,000	5,456,171	−156,171	5,354,190	−54,190	4,972,430	+327,570
1964	5,500,000	5,747,278	−247,278	5,648,006	−148,006	5,244,667	+255,333
1965	6,000,000	6,024,826	−24,826	5,930,526	−69,474	5,507,985	+492,015
1966	6,300,000	6,430,631	−130,631	6,335,270	−35,270	5,889,590	+410,410
1967	6,600,000	6,751,584	−151,584	6,655,888	−55,888	6,194,419	+405,581
Total	29,700,000	30,410,490	−710,490	29,923,880	−362,828	27,809,091	+1,890,909

certainly affected by major national events. (2) The formulation used tacitly assumes that no cars produced in a given year will be scrapped during that year. This assumption is clearly invalid, as a certain number of cars produced in a given year will certainly encounter severe accidents and be scrapped during the very year in which they are introduced into the cycle. However, the purpose of developing this model was to make predictions for the future, and, for that reason, the usefulness of the model would be greatly inhibited if it would be necessary to consider say, on a month-to-month basis, the new cars introduced into the cycle during any given scrap year. The usefulness of any predictive model is, of course, greatly compromised if it does not permit one to peer into the future. (3) Additionally, we should note that, by evaluating the definite integral in increments of exactly 1 year, we make the tacit assumption that all cars in a given scrap year are scrapped at the beginning of the scrap year, and that all cars produced in a preceding year are introduced into the cycle at midyear. The net effect is that these tacit assumptions tend to wipe out the error made by considering that no cars produced during a given year are scrapped in that year. In any event, as will be shown, the method that we have developed works in predicting, on a nationwide, State, and county basis, the number of cars which will likely be scrapped in each of the last 5 years.

The distribution used in this project is equivalent to one half of the normal distribution. If it is desired to evaluate the fraction of cars scrapped for values of mean life (y) and time (t) other than those shown in this report, a table of areas of the normal curve can be used. The usual table of areas in one half of a normal curve can be used by entering with $t/\sqrt{\frac{\pi}{2}y}$ and multiplying the table value by two.

It could well be argued that the normal distribution results in an unreal prediction regarding relatively new cars. For example, using the normal distribution and a mean life of 8 years, the distribution assumes that some 8 percent of the cars produced during a given year will be scrapped during the following year—a figure clearly too high. However, the fact that the normal distribution fits the data better than any other distribution tried, suggests that the very existence of a number of *new cars may force other older cars* to be retired—perhaps prematurely. Use of the normal distribution tends to take into account this forcing function that may cause the public to retire used cars at an accelerated rate because of the existence of new cars.

Despite the fact that the normal distribution so closely predicts the actual scrappage of the past 5 years, we have tried other distributions, specifically the Poisson and the Gamma. Neither of these distributions provides as good a data fit as does the normal distribution.

Using the probability function that was used for this project (if the cars have a mean life of 7.6 years), a car would have a 50 percent probability of surviving beyond 6.5 years.

It is noted that we have been discussing the number of cars *entering* the scrap cycle annually. The number actually reduced to scrap and sold to steel mills has not been estimated. Certainly, the lag between the time a hulk enters the cycle until it is reduced to scrap depends heavily on the economics of the local situation. In areas with shredders, there is ample evidence that the hulk inventory is not increasing as rapidly as it is for areas without shredders.

Results. The results of our nationwide prediction are given in Table 1 for values of y of 7.2, 7.6, and 8 years. It will be noted at once that the data for a value of 7.6 years match within 2 percent the actual number of cars scrapped during the last 5 years. Table 2 depicts the same data for the State of Maryland for a value

TABLE 2

MARYLAND SCRAPPAGE FIGURES—ACTUAL VERSUS PREDICTED

Scrap year	Best estimate of actual no. scrapped	Predicted number scrapped			
		$y=7.2$	Difference	$y=7.6$	Difference
1957	60,200	58,704	+1,496	56,590	+3,610
1958	10,470	64,154	−53,684	61,976	−51,506
1959	50,964	67,494	−16,530	65,371	−14,407
1960	85,455	71,911	+13,544	69,846	+15,609
1961	54,038	77,301	−23,263	75,289	−21,151
1962	62,826	81,872	−19,046	79,895	−17,069
1963	86,358	87,624	−1,256	85,685	+673
1964	92,510	94,919	−2,409	92,904	−394
1965	129,861	102,698	+27,163	100,603	+29,258
1966	115,559	111,734	+3,825	109,525	+6,034
1967	.....	119,982	.....	117,656	.....
Total	748,241	818,411	−70,160	797,684	−49,343

TABLE 3

GARRETT COUNTY SCRAPPAGE FIGURES—ACTUAL VERSUS PREDICTED

Scrap year	Best estimate of actual no. scrapped	Predicted number scrapped			
		$y=7.2$	Difference	$y=7.6$	Difference
1957	351	321	+30	310	+40
1958	277	347	−70	335	−58
1959	20	353	−333	343	−323
1960	407	361	+45	351	+56
1961	546	374	+172	366	+180
1962	214	378	−164	371	−157
1963	234	387	−153	380	−146
1964	230	403	−173	398	−168
1965	397	421	−24	416	−19
1966	653	447	+206	442	+211
1967	786	470	+316	465	+321
Total	4,115	4,262	−148	4,177	−63

TABLE 4

QUEEN ANNE'S COUNTY SCRAPPAGE FIGURES—ACTUAL VERSUS PREDICTED

Scrap year	Best estimate of actual no. scrapped	Predicted number scrapped			
		$y=7.2$	Difference	$y=7.6$	Difference
1957	372	284	+88	310	+62
1958	210	308	−98	335	−125
1959	266	317	−51	343	−77
1960	275	333	−58	351	−76
1961	310	352	−42	366	−56
1962	240	362	−122	371	−131
1963	307	376	−69	380	−71
1964	405	398	+7	398	+7
1965	270	414	−144	416	−146
1966	431	436	−5	442	−11
1967	413	456	−43	465	−52
Total	3,499	4,036	−537	4,177	−676

of 7.2 years and for a value of 7.6 years. The actual number of cars scrapped in the State of Maryland was not available from industry sources. We, therefore, made the best estimate of the number scrapped in any one of the past years by adding to the registrations of the previous year the new cars sold in the State of Maryland during the given year. Clearly, these calculations are based on the assumption that there is no net influx or egress of operable used cars during the year in question. This appeared to be the case for the State of Maryland, because a value of 7.6 years very closely predicts the number of cars calculated to have been scrapped in the past 5 years. Tables 3, 4, and 5 present the same sort of data for three representative counties of the State of Maryland: Garrett, Queen Anne, and Prince George's.

Simplified Method of Using the Statistics. MTI has programmed this predictive model on a digital computer, and we are in a position to provide predictive services for those who wish to obtain them from us. Our computer program is such that it is capable of taking into account local historical variances to provide a highly accurate estimate of scrap automobile generation in future years. However, we believed it desirable to provide

TABLE 5

PRINCE GEORGE'S COUNTY SCRAPPAGE FIGURES—ACTUAL VERSUS PREDICTED

Scrap year	Best estimate of actual no. scrapped	Predicted number scrapped			
		$y=7.2$	Difference	$y=7.6$	Difference
1957	5,303	6,125	−822	5,880	−577
1958	4,558	6,846	−2,288	6,585	−2,027
1959	2,794	7,428	−4,634	7,158	−4,364
1960	6,634	8,224	−1,590	7,945	−1,311
1961	10,087	9,239	+848	8,947	+1,140
1962	8,547	10,218	−1,671	9,910	−1,363
1963	9,273	11,460	−2,187	11,128	−1,855
1964	11,295	13,007	−1,712	12,639	−1,344
1965	13,310	14,858	−1,548	14,444	−1,134
1966	17,734	16,965	+769	16,498	+1,236
1967	16,853	18,971	−2,118	18,547	−1,694
Total	106,388	123,341	−16,953	119,681	−13,293

an approximate method that can be used by anyone with access to an adding machine (Table 6). This table is based on a value of y of 7.6 years. To use Table 6, proceed as follows: (1) Enter on the top the scrap year for which a prediction is to be made. Enter in column 1 the years, beginning at the top with the year preceding the scrap year. Enter in column 2 the number of new cars registered in the geographical area in question, beginning at the top of the table with the new cars introduced the year immediately prior to the year in question. (2) Multiply each of the numbers in column 2 by the factor given in column 3 and enter the results in column 4. The sum of the numbers in column 4 is the number of cars predicted to enter the scrap cycle in the year written on the top of the page. To determine the probable number of new cars to be entered for ears that have not yet occurred. plot the number of new cars introduced into the cycle against time as shown in Figure 1. Extend the curve to future years and pick off the probable number of cars that will be introduced in the cycle in future years.

TABLE 6

REFERENCE TABLE FOR CALCULATING THE NUMBER OF VEHICLES ENTERING SCRAP CYCLE IN A GIVEN YEAR

	A	*B*	*A* × *B* = *C*
Sales year	No. new cars introduced	Fraction of vehicles produced in sales year and scrapped in 19"n"	Product equals the no. vehicles produced in "sales year & scrapped in 19n"
19"n−1"	A(n−1)	.084	C(n−1)
19"n−2"	A(n−2)	.083	C(n−2)
19"n−3"	A(n−3)	.081	C(n−3)
19"n−4"	|	.078	|
19"n−5"	|	.075	|
19"n−6"	|	.071	|
19"n−7"	|	.066	|
19"n−8"	|	.061	|
19"n−9"	|	.056	|
19"n−10"	|	.051	|
19"n−11"	|	.046	|
19"n−12"	|	.040	|
19"n−13"	|	.035	|
19"n−14"	|	.031	|
19"n−15"	|	.026	|
19"n−16"	|	.022	|
19"n−17"	|	.019	|
19"n−18"	|	.015	|
19"n−19"	|	.013	|
19"n−20"	A(n−20)	.010	C(n−20)

Total no. vehicles scrapped in 19"n" = $\sum$C

Vehicle Sales in Maryland—A Projection

Introduction. Subsequent to checking the model against actual scrappage data, a forecast of future car sales in Maryland and its political subdivisions was made. The primary purpose of this projection was to provide a basis to which the model described above could be aplied in determining the future number and distribution of junked cars in Maryland.

The Technical Approach. Prior to projecting new car sales for Maryland and its political subdivisions, historical sales data was collected for all the counties of Maryland, the city of Baltimore, and the State of Maryland. Next, forecasts of future auto sales made by other organizations were examined. Prior to developing a sophisticated model for projecting future sales, several straightforward techniques were employed to determine whether or not projections made on these bases would provide future sales estimates in line with general expectations concerning the new car market.

The linear least squares method for developing trend lines was selected to project future car sales since: (1) The resultant data correlated with projections made by other organizations. (2) The method is straightforward and avoids the hazards of compounding errors present in a more sophisticated model while implicitely incorporating factors that create demand for new automobiles (such as greater per capita income, population growth, increasing mobility and leisure time) since past increases in motor vehicle sales have resulted from the growth trend present in these variables.

A least squares regression equation of the form

$$Y-\bar{Y}=\frac{\Sigma(X-\bar{X})(Y-\bar{Y})}{\Sigma(X-\bar{X})^2}(X-\bar{X})$$

where:

Y = the actual number of vehicles sold in year X

$\bar{Y}$ = the average (mean) number of vehicles sold in the years considered

X = an actual year in the sample

$\bar{X}$ = the median year in the sample used.

The resultant trend curve upon solution of the above equation is of the form $Y=a_0+aX$

where:

Y = the number of cars sold in year X

X = the year for which the projection is made

a_0 = a calculated constant

a_1 = the annual incremental increase in vehicle sales.

Using this formulation, projections for vehicle sales in Maryland and its political subdivisions presented on the following pages were developed. Actual car sales for 1947 through 1967 provided that base data for these projections. The resultant projections are presented in Exhibit IV in the text.

Projection of Junked Cars Entering the Scrap Cycle Annually From 1968 Through 1979

By applying the predictive model described earlier to the new car sales forecasts above, projections of the number of junked cars entering the scrap cycle from 1968 through 1979 were made for the State and counties of Maryland and the city of Baltimore. The projections, by year, are presented in Exhibit III in the text. The projected number of vehicles to be scrapped in Maryland in the year 1979 is 193,543, an increase of nearly 80,000 over the estimated 115,559 vehicles scrapped in 1967.

Appendix C. Long-Range Forecasts

Any year now, we will break through the 10,000,000-car-year barrier. By the late 1970's, we will show no particular elation over a 13,000,000-year.

LEE A. IACOCCA
Executive Vice President
North American Automotive Operations

Ford Motor Company
Press release (10-14-68)

By 1975, we expect to have more than 118 million motor vehicles, and the total should exceed 130 million by 1980. The Nation will need well over 8 million automobiles and more than 1.5 million trucks and buses in each of the next few years. By 1976, we will need over 10 million automobiles plus 2 million trucks and buses each year. By 1980, we'll have a total motor vehicle market in excess of 13 million vehicles a year.

E. M. COPE
Chief, Highway Statistics Divison
U.S. Department of Transportation
(9-11-68)

In 1985, when the U.S. population will be about 265 million persons, some 144 million motor vehicles will be on the move, traveling 1.5 trillion miles a year. This compares with today's 100 million vehicles traveling 960 billion miles annually.

Steelways
(9-68)

The trucking industry in 1980 will show 24 million trucks, 3 million new trucks per year, intercity freight revenues of $24 billion, and 738 billion intercity ton-miles of freight service.

American Trucking Association
Transportation and Trucking in 1980
(8-68)

Passenger car sales outside the United States and Canada of 13,500,000 units a year by 1976 are foreseen—a number that would have been astounding just a few years ago. Such sales would represent a 48 percent increase over the number of passenger cars sold in 1967, and a growth rate higher than that expected for the auto industry in the United States and Canada over the same period.

ROBERT STEVENSON
Executve Vice President
Overseas Automotive and Tractor Operations
Ford Motor Company
Press release (4-2-68)

PERCENT OWNERSHIP IN 1975

Household income (in 1967 dollars)	Total	Age of household head				
		Under 35	35–44	45–54	55–64	65 and over
Under $3,000	7.7	1.3	0.6	1.0	1.4	3.4
$3,000 to $5,000	11.2	3.0	1.4	1.6	2.0	3.2
$5,000 to $7,500	20.2	7.9	3.5	3.2	3.1	2.5
$7,500 to $10,000	22.6	8.9	4.6	4.4	3.5	1.2
$10,000 to $15,000	24.8	7.7	6.3	6.3	3.4	1.1
$15,000 and over	13.5	1.9	3.7	4.7	3.2	*
Total	100.0	30.7	20.1	21.2	16.6	11.4

*Percentage insignificant.

It is estimated that in the midseventies, 81 percent of the nation's households will own at least one car, and over a third of these, two or more. This will add up to about 80 million family cars on the road in 1975. The number of automobiles owned by the nation's families has increased at an average annual rate of over 3.5 percent thus far in the 1960's, but the pace is expected to decelerate to about 3.0 percent between now and the mid-1970's.

Source: The Conference Board Record, March 1968.

Foreign-car sales in the United States will more than double present volume to reach 14 percent of the market by 1975. Import car sales would reach a million by 1970 and go on to 1.6 million by 1975, compared with the peak of 773,200 in 1967.

M. S. McLAUGHLIN
Vice President
Ford Motor Company
Detroit Daily Press (1-17-68)

Statistical Department
Automobile Manufacturers Association
April 22, 1968

Motor vehicle registrations now stand at 94 million, but are expected to increase 38 percent during the next 13 years, reaching 130 million by 1980. During 20 years after that, they are projected to 182 million, another 40 percent increase.

Travel projections are even more spectacular with vehicle miles increasing 45 percent by 1980, and another 49 percent between 1980 and 2000.

J. O. MATTSON
President
Automotive Safety Foundation
Press release (11-13-67)

By the beginning of the next decade, we look for new car sales to reach the neighborhood of 10 million units a year. We expect to see new car sales of 13 million before 1980. The majority of travel in the

ROBERT ANDERSON
Vice President
Chrysler Corporation
The Evening Star (8-25-67)

cities will be by car, and the majority of goods will be delivered by truck by 1980, when auto and truck sales will total 15.3 million units.

Vehicle registration in the last 2 decades has almost tripled, increasing from slightly over 34 million in 1947 to today's 94 million. By 1975, our vehicle population will be nearly 120 million.

LOWELL K. BRIDWELL
Federal Highway Administrator
U.S. Department of Transportation
Press release (6–26–67)

The industry continues to look forward to a 10-million car year by 1975. The share of new car sales to families owning two or more automobiles increased from 31 percent in 1960 to 43 percent in 1965, and is expected to reach 54 percent by 1970.

VIRGIL E. BOYD
President
Chrysler Corporation
Press release (6–14–67)

The basic auto market in 1970 will run to approximately 9,500,000 new cars (including imports). That's only 200,000 more than the 9,300,000 new cars actually sold in the United States in 1965. In the early 1970's, unit demand will quicken largely because all those extra cars sold in the mid-1960's will begin to wear out. The market in 1975 will amount to 11,500,000 new cars.

Because sales were drab in the late 1950's and the first 2 years of the 1960's, the basic scrappage rate, which is now 6 million, will increase slowly over the next few years to 6.7 million in 1970. Later on, because the mid-1960's were big new-car years, scrappage will increase more quickly to 8.2 million in 1975. First time purchase of cars by households are projected to total 1,200,000 in 1970 and 1,350,000 in 1975. Two-car demand should add 1,100,000 autos to the market in 1970 and 1,400,000 in 1975.

Fortune
(6–1–67)

Despite fluctuations, we expect that U.S. demand will reach a level of almost 12 million cars by 1976. Factors that will bring about the increased demand are: (1) The car-buying population (people age 18 and older) will increase by 22 million or 17.5 percent

ARJAY MILLER
President
Ford Motor Company
Press release (5–18–67)

in the next 10 years. (2) A greater percentage increase is expected in the number of families earning $10,000 and over. From 12.2 million families in 1966, the number is expected to reach 24.2 million by 1976.

Despite the current sales decline, the automotive industry will have a 10-million car year by 1970 and a 12-million car year by 1975. Truck sales should hit 1.8 million by 1970 and 2 million by the mid-1970's.

JOHN J. RICCARDO
Group Vice President
Chrysler Corporation
Detroit News (4–11–67)

A 10-million-car year can't be far off, and a 12 million-year is in sight within a decade.

L. B. SMITH
President
A. O. Smith Corporation
Automotive News (3–20–67)

	Cars in use Jan. 1 (million)	New cars registered year (million)	Cars scrapped during year (million)
1963	59.66	7.56	5.32
1964	61.90	8.07	5.71
1965	64.26	9.31	E*6.00
1966E	67.58	9.20	6.25
1967E	70.53	8.00	5.75
1968E	72.78	9.25	6.25
1969E	75.78	10.50	7.00
1970E	79.28	12.50	8.00

*E, estimated. Source: Robert W. Baird and Company.

In 1965, we had record automobile sales of 9.3 million. With projections of substantially higher incomes and larger number of households, it would not be surprising if new car purchases exceed 13 million in 1975. Purchases of parts and accessories should also show a very sharp rise. Total purchases of autos and parts are projected to increase more than 70 percent by 1975 .

ALEXANDER B. TROWBRIDGE
Acting Secretary of Commerce
U.S. Department of Commerce
Press release (2–6–67)

The same powerful forces that have created the steadily growing demand for cars over the past 5 years will continue to operate in the years ahead. These forces include the steady growth of the population and the addition each year of millions of po-

LYNN TOWNSEND
Chairman
Chrysler Corporation
Press release (12–16–66)

tential new customers, the rise in personal income, and the increasing reliance upon the automobile for personal transportation. In the early 1970's, we expect these forces to create a yearly demand ranging between 9 and 12 million new cars.

U.S. car sales are projected to increase at a compound rate of 3.4 percent a year—to normal levels of about 10 million car sales a year by 1970, and 11.5 million by 1975. Dollar sales of new cars, at constant car prices, will increase at a compound rate of 4.6 percent a year. In comparable terms, Ford projects growth in truck sales of more than 5 percent a year. Unit car sales abroad will grow at a compound rate of 6 percent a year for the next 5 years tapering to about 4.5 percent in the 5 years thereafter.

HENRY FORD, II
Chairman
Ford Motor Company
Press release (12-2-66)

By the end of 1965 there were 75 million passenger cars on our streets, and the number is increasing by close to 3 million vehicles each year. This means the car population will total 84 million passenger cars by the end of the 1960's.

Replacement of cars already on the road is now in excess of 6 million a year, and should amount to about 6.9 million scrapped in 1969.

By the end of the decade, nearly 7 million new cars will be sold for replacement. New customers entering the market and families with one car adding a second (annual sales of 9 million cars) becomes a new base for projection.

ROY ABERNETHY
President
American Motors Corp.
Detroit News (11-27-66)

There are 80 million cars and trucks on American roads today and 116 million expected within 10 years.

ARJAY MILLER
President
Ford Motor Company
Detroit News (11-27-66)

The market value for automotive replacements parts for cars, trucks, buses, and trailers at retail in 1965 was $9 billion. Estimates place the value at $11.5 billion by 1970 and $14.7 billion by 1975.

The U.S. Economics Corporation estimates that 85 percent of 1970 auto models will have automatic transmissions, compared with 81 percent in 1965; 70 percent will have power steering, compared with 60 percent last year. For power brakes, the figures are 73 percent in 1965, compared with 83 percent in 1970. Total cars will have risen from 61.3 million in 1965 to 74.2 million by 1970.

Printers' Ink (10-14-66)

MOTOR VEHICLE PRODUCTION

(in thousands)

	1970	1975	1980
Passenger cars	9,400	10,600	12,200
Trucks	1,510	1,960	2,340
Buses	35	40	45
Total	10,945	12,600	14,485

Source: Battelle Memorial Institute, "Michigan Manpower Study, Phase I."

The expected deceleration in the 1967 auto market fits into the long-term outlook. Reasonably optimistic assumptions for 1970 indicate a market for about 10 million units, or only 7 percent above 9.3 million units in 1965, including imports.

Factors affecting the growth in car ownership and the pattern of replacement are: A modest recession in 1967, followed by a return to prosperity in 1968 to 1970. A rise in the percent of households owning cars (from 80.6 percent at the beginning of 1966 to almost 84 percent by the beginning of 1971). Rapid growth in the number of upper-middle and upper income families boosting multiple car ownership. A slow scrappage rate over the next 5 years, however, a marked gain should again occur in the early 1970's.

SOCIETY NATIONAL BANK OF CLEVELAND
Steel (8-15-66)

There is little prospect of any substantial rise above a new car market of 9 or 9.5 million for the next few years. Replacement demand required 6 million units, rising toward 7. Over 1 million additional cars are needed to provide transportation for the growing number of households, an additional million will go to satisfy the needs of increasingly richer households. This will provide a basic demand for new cars of 9.5 million by 1970.

DANIEL B. SUITS
Professor of Economics
University of Michigan
Challenge, May-June 1966

Averaging the up years with the down industry sales are projected to increase at a trend rate of 3.4 percent a year. This would mean normal levels of about 10 million cars by 1970, and about 11.5 million by 1975. Sales (including imports) in 1966 were projected at 9 million cars, second highest in history. Unit growth outside the United States for the coming 5 years was projected at 6 percent a

HENRY FORD, II, *Chairman*
ARJAY MILLER, *President*
J. EDWARD LUNDY, *Vice President, Finance*
Ford Motor Company
Press release (5-25-66)

year, tapering to 4 percent in the 5 years thereafter. By 1975, they projected that more than a third of the families will have two or more cars, compared to a quarter of all families today. Worldwide, about 170 million cars and trucks are now in use, and well over 200 million will be in use by 1970.

	1965	1975
Motor vehicle registrations (millions):		
Passenger cars	75	97
Trucks and buses	15	19
Total	90	116
Ratio of persons per motor vehicle:		
All persons	2.2	1.9
Persons 15–74 years old	1.4	1.3
Vehicle miles (billions)	870	1,165
Motor fuel consumption (billions of gallons)	70	93
Motor vehicle demand 1966–1975 (millions):		
Passenger cars:		
For replacement	68	
For increase in registrations	22	
Total	90	
Trucks and buses, total	14	

Source: A Look Through The Windshield, E. M. Cope, Chief, Highway Statistics Division, Office of Planning, Bureau of Public Roads, Address to the North American Gasoline Tax Conference, Denver, Colorado, August 30, 1965.

Well over 13 million vehicles will be sold in 1975 in the United States. This would compare with about 10.9 million sold in 1965. He said 1975 sales in Canada are expected to top 1 million units compared to 800,000 in 1965. Overseas sales are expected to be upwards of 16 million units in 1975, compared to about 10.8 million units in 1965.

FREDERIC G. DONNER
Chairman
General Motors Corp.
Press release (5-20-66)

	By 1970	By 1975
U.S. population (million)	213.	230.
Number of families (million)	54.	63.
New drivers—age 16 (million)	4.	4.3
Intercity freight-ton miles (trillion)	2.1	2.4
Cars in use (million)	86.	99.
Cars will travel (billion miles)	790.	902.
Trucks and buses in use (million)	19.4	23.6
Car production (million)	10.5	12.5
Car scrappage (million)	8.4	10.0
Non-U.S. car output (million)	14.5	19.0
U.S. truck output (million)	1.9	2.3

Source: Wards Automotive Reports, July 25, 1966.

Appendix D. Prices Paid by a Massachusetts Shredder Operator

Clean burned autobodies with frames, springs, rear ends, and front ends attached. Motors, transmissions, and *fuel tanks* must be removed.	$14.00/net ton.
Clean unburned autobodies with frames, springs, rear ends, and front ends attached. Motors transmissions, *fuel tanks*, seats, cushions and tires must be removed. (Glass, headliners, doorpanels, and floormats may remain in the body.)	$14.00/net ton.
Clean burned autobodies with or without frames Motors, transmissions, and *fuel tanks* must be removed.	$11.00/net ton.
Cleaned unburned autobodies with or without frames Motors, transmissions, *fuel tanks*, seats, cushions and tires must be removed. (Glass, headliners, doorpanels, and floormats may remain in the body.)	$11.00/net ton.
Porcelain: washing machines. Hot water heaters with jackets, stoves, and refrigerators. All sealed units must be removed.	$13.00/net ton.
Mixed sheet iron Must be free of cable, BX cable, balls and rolls of wire and straps, terneplate, new galvanized, silicon and tin coated materials. *Gas tanks*, paint cans, and closed containers are not acceptable.	$13.00/net ton.
Prepared no. 2 steel Truck undercarriages, shafting, bars, large pipe and gears, ordnance material, and all closed containers must be excluded.	$19.00/net ton.
Unprepared no. 2 steel—maximum length 12 ft May include whole *car frames*, front and rear ends, and oversized no. 2 scrap.	$15.00/net ton.

Appendix E. Excerpt From: Plants for Screening Junkyards, Gravelpits and Dumps

Arnoldra, Harvard University, November 1965

"Make America Beautiful" is a phrase which, fortunately, is being given much attention now. Three million dollars have just been appropriated by Congress for control of outdoor advertising and a like amount has been appropriated for "controlling junkyards along the highways." This is the very thing for which many a civic-minded group has been fighting during the past decade. It would not be amiss to take a hard look at some of our town dumps, and state-owned gravel pits also, with the idea of planting trees and shrubs to screen them from public view.

Public-spirited groups could well be active in planting, for it would add materially to the appearance of the countryside, especially as viewed by the passing motorist. Along the major highways around Boston's perimeter, several dumps, which are conspicuously unshielded, come to mind. This is a condition too often repeated in many communities throughout the country.

The sites of these depositories have undoubtedly been selected because the land is poor or unwanted. Also, it is impractical to expect that, if a highly ornamental planting were made in such places, it would be maintained. The realistic approach is to admit that these areas are necessary, that they cannot be moved at this point, and that no individual or group will give the time or money to mow lawns, or care for extensive flower beds and ornate plantings, year in and year out.

However, there might be those interested enough to make an initial planting of rugged, fast-growing trees and shrubs; that is, plants which, once established, have a good record for taking care of themselves without much additional attention. True, such plants might not be the best ornamentals available, but the chances are that the soil would not be the best either. This bulletin is being written with the hope that some action, by some group, somewhere, may be taken in hiding these places from public view with plantings of comparatively inexpensive screens of "low maintenance" trees and shrubs.

These plants should be given the best possible attention at planting time with good soil, water, and mulching. It is particularly necessary that the plants be checked and watered carefully during the first 2 years of the planting, even periodically, where needed. Arrangements and funds for doing this should be the responsibility of the planning organization, and funds should be provided for this at the start of the project. Many a good, well-

conceived planting has failed because this was not done at the start.

Of the plants suggested in the following lists, the fastest growing trees are the poplars, willows, elms, and the Douglas-fir, in that order. Of the shrubs, the fastest growing are the Forsythia, Japanese Tree Lilac, Sweet Mock-orange and Japanese Rose. In addition, and probably the fastest growing of all the shrubs suggested here for making a quick screen, is the new *Rhamnus frangula* "Columnaris", the Tall-hedge Buckthorn. Using plants 2–3 feet high, a 12-foot hedge can result in five years in good soil. Plants should be placed 3–4 feet apart to make a solid screen. They bear berries (red, turning black) throughout the summer and are most attractive to birds. The ability of this plant to grow well and fast, its freedom from serious pests, its narrow and very dense habit (not much over 4 feet wide), its glossy foliage, and the ease with which it is transplanted, all combine to make it an ideal, quick-growing screen, well suited to shield dumps and gravel pits from the public view.

SCREENING TREES FOR DRY, SANDY SOILS

		Hardiness	
		Ht.	*Zone*
Acer negundo	Box-elder	60′	2 E
Ailanthus altissima	Tree of Heaven	60′	4 E
Betula populifolia	Gray Birch	30′	3–4 B
Fraxinus pennsylvanica lanceolata	Green Ash	60′	2 E
Maclura pomifera	Osage-orange	60′	5
**Pinus banksiana*	Jack Pine	75′	2 B
Populas alba	White Poplar	90′	3 E
Sassafras albidum	Sassafras	60′	4 B
Sophora japonica	Japanese Pagoda Tree	75′	4
Ulmus pumila	Siberian Elm	75′	4 E

* = Evergreen E = Easy to move B = Must be moved carefully with a ball of soil

SCREENING SHRUBS FOR DRY AND SANDY SOILS

		Hardiness	
		Ht.	*Zone*
Acer ginnala	Amur Maple	20′	2
Berberis thunbergii	Japanese Barberry	7′	4 E
Caragana arborescens	Siberian Pea-tree	18′	2 E
Comptonia peregrina	Sweet Fern	4′	2 B
Elaeagnus angustifolia	Russian Olive	20′	2 B
Hamamelis virginiana	Common Witch-hazel	15′	4 E
**Juniperus communis*	Common Juniper	3–30′	2 B
**Juniperus virginiana*	Red-cedar	10–90′	2 B
Kolkwitzia amabilis	Beauty-bush	10′	4 E
Ligustrum amurense	Amur Privet	15′	3 E
Lycium halimifolium	Common Matrimonyvine	5′	4 E
Myrica pennsylvanica	Bayberry	9′	2 B
Physocarpus opulifolius	Eastern Ninebark	9′	2 E
Prunus maritima	Beach Plum	6′	3 B
Rhamnus frangula	Alder Buckthorn	18′	2 E
Rhus aromatica	Fragrant Sumac	3′	3
Rhus copallina	Shining Sumac	30′	4 B
Rhus glabra	Smooth Sumac	9–15′	2 B
Rhus typhina	Staghorn Sumac	30′	3 B
Rosa rugosa	Rugosa Rose	6′	2 E
Viburnum lentago	Nannyberry	30′	2

* = Evergreen E = Easy to move B = Must be moved carefully with a ball of soil

SCREENING TREES FOR NORMAL SOILS

		Hardiness	
		Ht.	Zone
Acer platanoides	Norway Maple	90′	3 E
Catalpa speciosa	Northern Catalpa	90′	4 E
Cercidiphyllum japonicum	Katsura Tree	60–100′	4
**Juniperus chinensis*	Chinese Juniper	60′	4 B
Morus alba	White Mulberry	45′	4
**Picea abies*	Norway Spruce	150′	2 B
**Picea pungens*	Colorado Spruce	100′	2 B
**Pinus resinosa*	Red Pine	75′	2 B
**Pinus strobus*	Eastern White Pine	100–150′	3 B
Populus nigra 'Italica'	Lombardy Poplar	90′	2 E
**Pseudotsuga menziesii*	Douglas-fir	100–300′	4–6 B
Quercus borealis	Red Oak	75′	4
Quercus palustris	Pin Oak	75′	4
Salix alba 'Tristis'	Golden Weeping Willow	75′	2 E
Salix babylonica	Babylon Weeping Willow	30′	6 E
Salix X blanda	Wisconsin or Niobe Weeping Willow	40′	4 E
Salix X elegantissima	Thurlow Weeping Willow	40′	4 E
**Thuja occidentalis*	American Arbor-vitae	60′	2 B
Tilia cordata	Little-leaf Linden	90′	3
**Tsuga canadensis*	Canada Hemlock	90′	3 B
Ulmus parvifolia	Chinese Elm	50′	5
Viburnum prunifolium	Blackhaw	15′	3 B
Viburnum sieboldii	Siebold Viburnum	30′	4 B

* = Evergreen E = Easy to move B = Must be moved carefully with a ball of soil

SCREENING SHRUBS FOR NORMAL SOILS

		Hardiness	
		Ht.	Zone
Cornus mas	Cornelian Cherry	24′	4 E
Forsythia X intermedia	Border Forsythia	9′	5 E
Lonicera maackii podocarpa	Amur Honeysuckle var.	15′	4 E
Philadelphus coronarius	Sweet Mock-orange	9′	4 E
Rhamnus frangula 'Columnaris'	Tallhedge Buckthorn	12′	2 E
Rosa multiflora	Jananese Rose	10′	5 B
Rosa setigera	Prairie Rose	15′	4 E
Spiraea X vanhouttei	Vanhoutte Spiraea	6′	4 E
Syringa amurensis japonica	Japanese Tree Lilac	30′	4 E
Syringa X chinensis	Chinese Lilac	15′	5 E
Syringa josikaea	Hungarian Lilac	12′	2 E
Syringa X prestoniae	Preston Lilac	9′	2 E
Syringa vulgaris	Common Lilac	20′	3 E
Taxus cuspidata	Japanese Yew	50′	4 B

* = Evergreen E = Easy to move B = Must be moved carefully with a ball of soil

Appendix F. Technological Developments in the Scrap Industry

The following is the text of a presentation by I. Proler, Proler Steel Corporation, the largest firm in the scrap shredding business, delivered in October 1964 to the ISIS-sponsored meetings of the National Conference on Auto Salvage.

I am here to discuss with you the baling, shearing, and shredding methods of preparing the scrapped automobile for steel mill or foundry consumption, and the ultimate rolling of it into finished steel plates and shapes for fabrication into consumer items.

First, I will go back 25 to 30 years when the only method of salvaging scrap from an abandoned or a scrapped automobile was to chop up or torch the body into pieces small enough to be baled in a small hydraulic baler.

This end product was known as a No. 2 bundle. The understructure of the automobile was cut by acetylene torch or small alligator shear into 5- by 1½-ft. pieces or smaller, known in the trade as No. 2 heavy melting steel. Both of these items were consumed in open hearth furnaces.

The No. 2 bundles were approximately 30 by 24 by 24 in. or smaller. However, they contained the contaminants of paint, wood, nonferrous metal attachments, and so forth. The understructure contained copper gasoline tubing as well as the copper wiring attachments.

While No. 2 bundles and No. 2 heavy melting steel were consumed by the steel mills when steel demand was high, in most cases, they had to be diluted with hot metal from the mill's blast furnace to keep the residual copper and other nonferrous contaminants to a minimum, and to meet the ultimate specifications of the finished steel product.

As the years progressed, the hydraulic balers became larger, and the alligator shears, in some cases, were replaced by the larger hydraulic guillotine shears. Now the the balers were able to consume an entire automobile, with or without the understructure. The hydraulic shears were able to take an entire car, compress it and shear it into a scrap item known in the trade today as automobile slabs, or sheared auto scrap.

These methods, while they increased the number of automobiles that could be processed, still did not eliminate the contaminants while the steelmakers were restricted to higher and more rigid specifications for their finished products. This scrap could only find a home when it was attractively priced and when steel production reached a point when it was practical to consume the scrap in a bath with the necessary hot metal, generated by the blast furnace, to produce an ingot which could then be rolled into a satisfactory steel product.

During this period, Proler Steel Corporation operated the largest baling press in the world in Houston, Texas. This giant could consume and hydraulically compress two automobiles at one time, in 1½ to 2 minutes. By this method, I might add, a tremendous number of automobiles went into finished bales. Yet, there were many times when these bales had to be accumulated and held in inventory until steel mill buyers found this item attractive for their mill, or steel production was high enough to absorb this product, or perhaps until it could be exported to friendly foreign nations.

(At this point, a film was shown which was narrated by Mr. Proler.)

In this first scene, a grapple picks up the automobile from an accumulation of automobiles in the scrap processor's yard. The entire auto minus the radiator, the motor, and the tires will be dropped into a hydraulic press and will be compressed into a No. 2 bundle.

This scene shows an automobile being lifted by a crane into a large hydraulic guillotine shear. This auto, with the understructure, will be compressed and then sheared into a product known an automobile slabs or sheared auto scrap, as I mentioned before. These shears can, I imagine, shear perhaps 20 or 25 cars an hour. You will note in the shearing device that the contaminants are torn loose and fall to the ground as the finished shear product is moved down the conveyor and loaded into cars.

The next scene shows the Prolerizer plant in Kansas City, Missouri, where whole automobiles are moved in from the rural and surrounding areas by trailer trucks, by wreckers' trucks, and by individual owners. The cars come in from an area 250 to 300 miles from the plant. At the Proler plant in Houston, cars are shipped in by railroad from 500 to 600 miles away. Some cars are flattened and stacked on flat-bed trailers, 25 to 30 to a load. Some autos are burned before they come in, some are not.

The auto is loaded onto the conveyor of the Prolerizer to begin its preparation as Prolerized steel. The scrap moves on a 200-ft conveyor that is fed by two, sometimes three, cranes. In this process, automobiles, washing machines, refrigerators, and similar articles are moved through a furnace to eliminate lead, solder, and other contaminants.

The Prolerizer is a gigantic mill that consumes and reduces these items into small bits. After the first step has been completed, the refining process begins. Some contaminants still remain. In the first magnetic separation, some are removed because the ferrous material adheres to the magnet. It is then carried away for further processing.

Rubber from the doors, the porcelain, the dirt, and the undercoating all are poison to steel mills. We are eliminating these materials in the Prolerizing process. This unwanted material moves by conveyor into a hopper for use as landfill. The nonferrous scrap produced by this method is recovered.

The finished product is high-quality scrap. The contaminants and the nonferrous material has been eliminated, and the end product is a clean and dense scrap widely consumed by domestic and foreign steel mills and foundries.

In the latter part of 1956 and throughout 1957, the research and development-engineering department of the Proler Steel Corporation worked to devise a method whereby contaminants could be eliminated from wrecked or abandoned automobiles and converted into a product for steel mills and foundries. It had to be a product of high quality and low enough in residual elements so that the consumers could use it steadily in their furnaces to make an ingot or finished product within the specifications required by metallurgists and their customers and which could be fabricated into automobiles, household appli-

ances, construction materials, and other items.

It was our feeling that if we could return the auto, the refrigerator, and the stove back to the steel that it was before it was made into those products, we could have a good, clean, high-quality grade of scrap. We have done this at Proler. Although we operated the largest baling press in the world at the time, we made it obsolete with the development of our Prolerizer plant.

This new type scrap has been copyrighted under the name of Prolerized steel scrap, and this method is covered by U.S. Patent No. 2,943,930 issued June 5, 1960. On August 29, 1961, a reissue patent, No. 25,034, was issued that strengthens the existent patent process and the product made by the process.

Prolerized scrap is a homogeneous type heavy metal scrap, chemically pure and physically dense. This material will weigh approximately 80 to 90 lbs. per cubic ft., and we have had some material that Prolerized as high as 105 lbs. per cubic ft.

This material can and is being moved by electromagnets, conveyors, and grapples. It is small and dense enough to be stored in a hopper. It can and is being consumed in all types of cast iron and steelmaking facilities.

I would like to quote, if I may, from Mr. R. L. Gray, past chairman of the board of Armco Steel Corporation, who, after making an inspection of our plant in Houston, stated, "The Prolerized process to me represents the greatest contribution to the steel industry ever made by the suppliers of scrap metal."

At the present time, there are four Prolerizer plants operating in the United States. Besides the plant in Houston, we operate the Prolerized Steel Corporation with our associates, I. J. Cohen and Company in Kansas City. A plant is operated in Los Angeles in association with Hugo Neu Company. Our newest plant, the Prolerized Chicago Corporation, began operation in the latter part of 1963 in conjunction and association with the M. S. Kaplan Company.

These plants can consume and process two autos per minute, or 800 to 1,000 autos a day. Two or three additional plants of this type are now in the planning stage, and will be erected in the eastern part of the country. One or two more will be put up in the midwest and there will be a plant in the San Francisco Bay area in the near future.

Prolerized steel has been tested and melted by most of the major steelmakers in the country. Mills such as Armco, La-Clede Steel, Northwestern Steel and Wire, and numerous other consumers throughout the country, as well as steelmakers in Europe and the Far East, commonly refer to this item as a "steelmaker's dream" because it is so versatile in their steelmaking procedures.

All of the Prolerizer plants that have been constructed have met with all of the air pollution, smoke, and dust requirements of the metropolitan communities in which they operate. This has been accomplished by the construction of special and elaborate equipment to curb possible pollution conditions.

The Department of Air Pollution of Chicago stated, "Our observation leads us to the conclusion that the Prolerizer has provided a significant contribution to the alleviation of a major problem of air pollution which confronts Chicago and other major cities. All potential sources of air pollution in the Prolerizer organization are controlled by passing the exhaust gasses through an elaborate type of control device. This insures to the greatest possible extent that no gasses or other air pollution is projected into the air during the Prolerizer operation."

Prolerized scrap is not made by a single machine, but a series of machines and devices including air pollution control equipment, constituting a fully integrated plant. The cost of an installation of this type is

upwards of $2 million, according to the location. Prior to the development of this process, auto wreckers and scrap operators could only move scrap automobiles whenever the market was economically sound. With the advent of the Prolerizer, a constant market is available for the end product. Consequently, a fair price is paid to the auto wreckers, or individuals who scrap abandoned automobiles.

While these plants are located in metropolitan areas, the price paid for cars draws them from a 250 to 300 mile radius of the plant. Some rail shipments are moved within a 500 to 600 mile radius of the plant.

I might add that seldom has a scrap operator been acclaimed by the auto wrecking industry for his part in auto salvaging. The confirmed feeling of the wreckers toward the Prolerizer coming into their area is one of gratitude, for they benefit as well as the community as a whole.

We have developed a way of continuously disposing of the older vehicles that have been a risk and a problem to the entire community. By providing a steady market for the cars and by disintegrating the vehicle into choice scrap, we have greatly assisted the wrecker, as well as performed a community service. The old dumps are being cleaned. Old automobiles that usually provide rodent harborage as well as constitute a fire hazard have been eliminated.

In closing, I would like to state that the symptoms of the problem that we face have been diagnosed by ourselves and members of the Institute. We feel that we have the necessary tools and knowhow to cure this malady. Through the ingenuity of this industry, and the construction of future Prolerizer plants through the country, I firmly believe that this cancer that has plagued the communities of this country will definitely be cured.

Appendix G. Used-Tire Reuse

One of the most serious problems resulting from the increasing number of vehicles traveling our roadways is the accumulation of used tires for which no satisfactory method of reuse or disposal has been implemented. The demand for used rubber is not sufficient to consume more than a fraction of the used tire inventory. Disposal of tires at sanitary land fill sites has not been successful since the tires rise to the surface due to air pockets. Because of the difficulties associated with disposal of tires, most dumps are charging very high prices per ton to accept them.

Recent research conducted by the Coal Research Center of the U.S. Bureau of Mines in Pittsburgh, using an idea originally conceived by scientists of the Firestone Tire & Rubber Company, has shown promising results as a potential solution to the problem of accumulating used tires.

Large quantities of chemicals, oil liquids, gas, and tar have been obtained from discarded tires by heating them in a closed vessel. Tires are fed into the reactor and, as they are heated, they break down. High Btu gas for heat and power is obtained and the liquids are distilled into valuable chemicals.

A series of tests at 500 °C produced 140 gal of liquid oils and 1,500 cubic ft of gas per ton of tires. The gas is comparable in heating value to natural gas. The chemicals obtained from the tires are similar to those produced from coal carbonization (the heating of coal without air), including benzene, toluene, xylene, and naphthas.

These tests indicate that the solution to the problem of discarded tires may be solved in the future. Firestone is currently looking at the economic feasibility of processing tires in this manner.

Until this process is proven economically feasible, continuing investigation is required to determine the feasibility of other methods for breaking tires.

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EXHIBIT III. STATE AND C

	State of Maryland	City of Baltimore	Alle-gany	Anne Arundel	Balti-more	Calvert	Caroline	Carroll	Cecil	Charles	
Estimated number of auto dismantlers.	686–717	36	16	119	32	4	12–16	32–50	24	24	
Estimated vehicles in dismantlers' yards.	151,990–162,790	15,000	6,500	3,000	50,000–60,000	400	1,000	4,500	2,540	4,000	
Scrap Processors – type of equipment.	(2 Shredders planned) Shears – 8 Balers – 6	(2 Shredders planned) Shears – 5 Balers – 3	Baler – 1								
Vehicles abandoned annually (estimated).	22,685–23,180	7,500	150	25–50	410	20	100	800	1,000	1,000	
Registered vehicles to nearest thousand		371,000	47,000	149,000	309,000	9,000	14,000	40,000	27,000	22,000	1
Public dumps / Private dumps	126 / 12	2 / 0	2 / 0	10 / 6	3 / 0	3 / 0	1 / 0	8 / 0	5 / 0	1 / 0	5
Solid waste disposal 1968 estimates – in tons by county (minimum and maximum).	2,709,444–3,386,805	669,045–836,062	65,481–81,851	199,545–249,532	425,502–531,878	14,089–17,611	15,337–19,172	46,654–58,318	42,369–53,509	28,952–36,190	22
Forecast of junked autos											
1968	124,187	28,276	2,128	8,411	21,830	597	572	1,866	1,319	1,289	
1969	130,625	28,747	2,188	8,928	23,156	624	581	1,942	1,370	1,361	
1970	136,955	29,179	2,243	9,439	24,474	650	589	2,015	1,418	1,431	
1971	143,155	29,572	2,294	9,947	25,773	676	597	2,086	1,466	1,502	
1972	149,482	30,040	2,351	10,463	27,092	702	605	2,159	1,515	1,572	
1973	155,899	30,552	2,412	10,984	28,429	729	615	2,236	1,565	1,645	
1974	162,209	31,020	2,469	11,500	29,745	756	624	2,310	1,614	1,715	
1975	168,507	31,448	2,523	12,008	31,033	782	632	2,382	1,661	1,785	
1976	174,557	31,865	2,579	12,514	32,313	808	640	2,453	1,709	1,854	
1977	180,816	32,346	2,636	13,029	33,614	834	649	2,525	1,758	1,925	
1978	187,077	32,845	2,692	13,549	34,917	861	657	2,598	1,808	1,996	
1979	193,543	33,408	2,755	14,077	36,251	888	667	2,672	1,862	2,069	

B

HIBIT III. STATE AND COUNTY DATA—CURRENT AND PROJECTED

	COUNTIES													
rroll	Cecil	Charles	Dor-chester	Frederick	Garrett	Harford	Howard	Kent	Mont-gomery	Prince Georges	Queen Anne's	Saint Mary's	Somerset	Talb
32–50	24	24	30–35	13	3–4	19	10	1	3	100	56	21	13	
4,500	2,540	4,000	700	7,100	2,000	15,000	750	100	800	25,000	500	1,000–1,500	300	5
									Baler–1	(1 Shredder planned) Shear–1 Baler–1				
800	1,000	1,000	100	250	100–200	3,000	75	100	1,800	4,000	10–50	500	200	100–
40,000	27,000	22,000	18,000	47,000	12,000	57,000	33,000	10,000	282,000	312,000	11,000	20,000	9,000	16,
3 / 0	5 / 0	1 / 0	5 / 0	3 / 6	4 / 0	10 / 0	2 / 0	3 / 0	1 / 0	6 / 0	12 / 0	10 / 0	7 / 0	0 /
6,654–58,318	42,369–53,509	28,952–36,190	22,864–28,580	64,430–80,537	16,104–20,622	73,790–92,956	37,872–47,340	11,665–14,582	328,120–410,150	434,788–543,485	12,636–15,795	32,426–40,533	14,534–18,168	17,1 21
1,866	1,319	1,289	916	2,231	478	2,683	1,664	470	21,240	20,350	469	1,015	482	
1,942	1,370	1,361	943	2,329	487	2,797	1,781	480	22,676	21,940	482	1,061	483	
2,015	1,418	1,431	969	2,422	496	2,907	1,898	489	24,111	23,525	493	1,104	483	
2,086	1,466	1,502	995	2,514	504	3,014	2,011	498	25,499	25,077	504	1,147	482	
2,159	1,515	1,572	1,021	2,610	512	3,117	2,126	507	26,913	26,640	516	1,191	482	
2,236	1,565	1,645	1,048	2,707	521	3,231	2,259	517	28,350	28,209	528	1,236	483	
2,310	1,614	1,715	1,074	2,801	529	3,342	2,367	526	29,771	29,768	540	1,280.	483	
2,382	1,661	1,785	1,100	2,894	537	3,448	2,481	535	31,166	31,305	551	1,323	483	
2,453	1,709	1,854	1,126	2,987	546	3,554	2,594	545	32,547	32,831	563	1,367	483	
2,525	1,758	1,925	1,153	3,082	554	3,662	2,717	555	33,965	34,380	575	1,411	484	
2,598	1,808	1,996	1,180	3,173	563	3,773	2,886	565	35,386	35,933	587	1,455	484	
2,672	1,862	2,069	1,209	3,268	573	3,882	3,043	576	36,821	37,495	600	1,500	486	

PROJECTED

TIES

	Howard	Kent	Mont-gomery	Prince Georges	Queen Anne's	Saint Mary's	Somerset	Talbot	Washing-ton	Wicomico	Wor-cester
9	10	1	3	100	56	21	13	4	18	6	5
0	750	100	800	25,000	500	1,000–1,500	300	500–800	8,000	1,800	1,500
			Baler–1	(1 Shredder planned) Shear–1 Baler–1					Shears–1	Shears–1	
0	75	100	1,800	4,000	10–50	500	200	100–200	350–400	100	500
0	33,000	10,000	282,000	312,000	11,000	20,000	9,000	16,000	59,000	37,000	16,000
	2 / 0	3 / 0	1 / 0	6 / 0	12 / 0	10 / 0	7 / 0	0 / 0	12 / 0	8 / 0	8 / 0
– 6	37,872–47,340	11,665–14,582	328,120–410,150	434,788–543,485	12,636–15,795	32,426–40,533	14,534–18,168	17,133–21,416	78,278–97,847	38,960–48,883	18,870–23,588
3	1,664	470	21,240	20,350	469	1,015	482	780	2,778	1,778	832
7	1,781	480	22,676	21,940	482	1,061	483	803	2,888	1,834	848
7	1,898	489	24,111	23,525	493	1,104	483	824	2,995	1,887	862
4	2,011	498	25,499	25,077	504	1,147	482	844	3,098	1,937	875
7	2,126	507	26,913	26,640	516	1,191	482	866	3,206	1,990	889
1	2,259	517	28,350	28,209	528	1,236	483	889	3,316	2,046	905
2	2,367	526	29,771	29,768	540	1,280	483	910	3,422	2,098	919
8	2,481	535	31,166	31,305	551	1,323	483	931	3,524	2,150	932
4	2,594	545	32,547	32,831	563	1,367	483	952	3,626	2,203	946
2	2,717	555	33,965	34,380	575	1,411	484	975	3,733	2,257	961
3	2,886	565	35,386	35,933	587	1,455	484	996	3,839	2,310	976
2	3,043	576	36,821	37,495	600	1,500	486	1,019	3,949	2,367	992

A

EXHIBIT IV.

Actual:	State of Maryland	City of Baltimore	Allegany	Anne Arundel	Baltimore	Calvert	Caroline	Carroll	Cecil	Charles	Dore
1948	47,230	19,778	1,131	2,177	6,455	267	470	962	537	421	
1949	61,568	24,697	1,596	3,163	8,367	331	544	1,347	835	602	
1950	84,233	32,482	2,265	4,272	12,271	431	713	1,645	999	745	
1951	76,874	26,071	1,761	3,703	10,559	404	591	1,481	950	729	
1952	65,063	21,751	1,349	3,345	8,834	343	445	1,111	926	645	
1953	86,145	28,707	1,899	4,371	12,477	441	601	1,468	1,151	880	
1954	82,594	33,034	2,037	5,439	15,193	482	606	1,583	1,302	983	
1955	116,897	37,362	2,175	6,508	17,910	524	612	1,699	1,454	1,087	
1956	99,621	31,152	1,974	5,957	16,153	458	566	1,625	1,255	918	
1957	97,425	29,356	2,015	5,612	15,772	456	520	1,525	1,147	975	
1958	79,469	22,084	1,515	4,949	13,343	449	353	1,268	891	720	
1959	97,276	24,810	1,827	6,209	17,069	531	451	1,443	1,035	981	
1960	114,339	27,036	2,209	7,016	20,804	566	547	1,588	1,234	1,099	
1961	110,319	24,964	1,921	6,979	19,241	497	461	1,487	1,051	1,190	
1962	129,511	27,748	2,245	8,601	24,029	664	621	1,721	1,312	1,540	
1963	151,690	31,961	2,527	10,593	27,621	717	608	2,141	1,605	1,557	
1964	163,080	31,748	2,739	11,484	28,512	789	627	2,478	1,619	1,799	
1965	183,604	34,147	2,968	12,941	33,641	874	736	2,738	2,065	1,940	
1966	180,911	31,858	2,179	14,226	33,314	912	790	2,709	1,667	1,828	
1967	172,839	30,290	2,518	13,206	30,961	655	649	2,564	1,553	1,797	
Projected:											
1968	177,345	33,244	2,649	12,404	32,733	823	658	2,496	1,753	1,881	
1969	183,760	33,713	2,707	12,965	34,073	850	667	2,569	1,804	1,954	
1970	190,175	34,183	2,766	13,527	35,413	877	675	2,643	1,854	2,026	
1971	196,590	34,652	2,825	14,088	36,753	904	684	2,717	1,905	2,099	
1972	203,005	35,121	2,884	14,650	38,093	932	692	2,791	1,956	2,171	
1973	209,420	35,591	2,942	15,211	39,433	959	700	2,864	2,007	2,243	
1974	215,835	36,060	3,001	15,772	40,773	986	709	2,938	2,058	2,316	
1975	222,250	36,529	3,060	16,334	42,113	1,013	717	3,012	2,108	2,388	
1976	228,665	36,998	3,118	16,895	43,453	1,040	726	3,085	2,159	2,461	
1977	235,080	37,468	3,177	17,457	44,793	1,067	734	3,159	2,210	2,533	
1978	241,495	37,937	3,236	18,018	46,133	1,094	742	3,233	2,261	2,605	

B

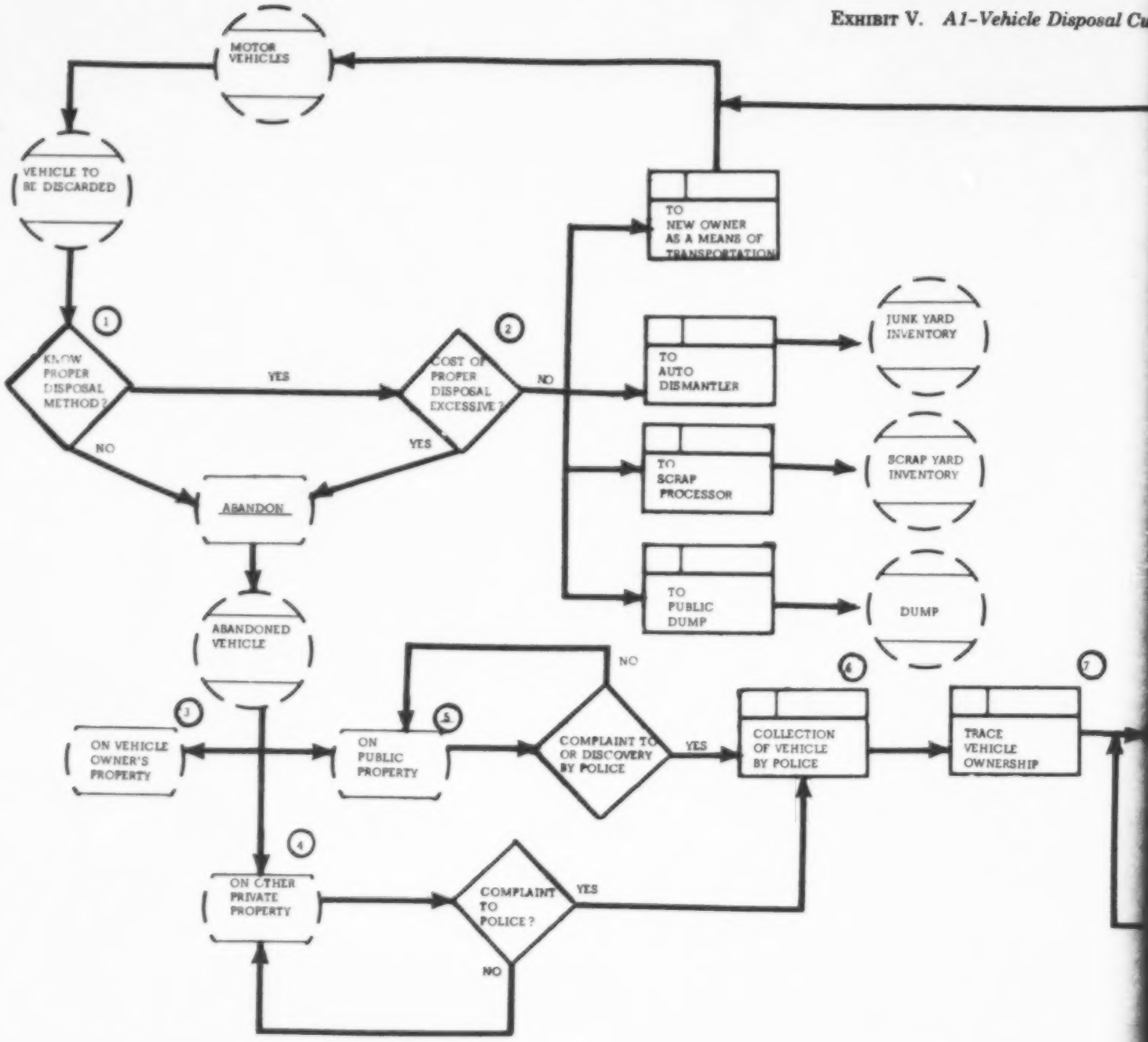
EXHIBIT IV. NEW CAR SALES—ACTUAL AND PROJECTED

	COUNTIES											
ll	Cecil	Charles	Dorchester	Frederick	Garrett	Harford	Howard	Kent	Mont-gomery	Prince Georges	Queen Anne	Sal Mar
962	537	421	522	1,089	321	1,254	546	278	3,983	2,211	301	
947	835	602	700	1,534	444	1,684	721	431	4,861	3,419	410	
545	999	745	876	1,918	507	2,100	944	434	11,666	8,358	446	
481	950	729	736	1,564	516	2,919	806	442	10,008	7,985	388	
111	926	645	717	1,297	422	1,624	694	402	8,018	7,692	350	
468	1,151	880	924	1,743	513	1,988	839	544	11,099	9,753	468	
583	1,302	983	907	1,816	501	2,258	796	513	14,161	12,229	481	
599	1,454	1,087	890	1,889	489	2,528	1,107	481	17,223	14,706	495	
325	1,255	918	809	1,573	494	2,128	1,055	440	13,988	12,145	361	
525	1,147	975	770	1,877	490	2,116	989	449	13,388	11,357	461	
268	891	720	614	1,496	312	1,597	865	330	12,801	10,463	312	
443	1,035	981	765	1,718	350	2,009	1,217	407	16,295	13,645	411	
588	1,234	1,099	850	1,969	440	2,353	1,434	512	20,067	16,916	476	
487	1,051	1,190	887	1,863	360	2,214	1,434	428	20,182	17,301	391	
721	1,312	1,540	932	2,230	430	2,826	1,684	424	22,886	21,164	472	
141	1,605	1,557	1,050	2,631	534	3,467	2,176	478	27,357	25,441	561	
478	1,619	1,799	1,085	2,917	572	3,836	2,472	569	29,290	29,989	526	
738	2,065	1,940	1,247	3,276	674	1,489	2,663	577	33,856	34,053	607	
709	1,667	1,828	1,191	3,349	654	4,715	2,767	597	31,970	34,261	610	
564	1,553	1,797	1,106	3,006	519	4,477	2,584	549	30,916	3[illegible]84	580	
496	1,753	1,881	1,155	3,033	561	3,613	2,620	562	32,953	34,055	577	
569	1,804	1,954	1,182	3,128	570	3,722	2,730	572	34,402	34,637	589	
643	1,854	2,026	1,209	3,223	578	3,831	2,840	582	35,851	36,218	601	
717	1,905	2,099	1,236	3,318	587	3,940	2,950	592	37,300	37,800	613	
791	1,956	2,171	1,263	3,413	596	4,049	3,060	602	38,749	39,382	625	
864	2,007	2,243	1,290	3,508	604	4,157	3,170	612	40,197	40,963	637	
938	2,058	2,316	1,317	3,603	613	4,266	3,280	622	41,646	42,545	649	
012	2,108	2,388	1,344	3,698	621	4,375	3,390	632	43,095	44,126	661	
085	2,159	2,461	1,371	3,793	630	4,484	3,500	642	44,544	45,708	673	
159	2,210	2,533	1,398	3,889	639	4,593	3,610	652	45,993	47,290	686	
233	2,261	2,605	1,425	3,984	647	4,701	3,720	662	47,441	48,871	698	

Howard	Kent	Mont-gomery	Prince Georges	Queen Anne	Saint Mary's	Somerset	Talbot	Washing-ton	Wicomico	Worcester
546	278	3,983	2,211	301	398	482	493	1,463	961	600
721	431	4,861	3,419	410	676	516	648	1,821	1,300	741
944	434	11,666	8,358	446	914	654	750	2,393	1,686	951
806	442	10,008	7,985	388	767	586	638	2,023	1,509	801
694	402	8,018	7,692	350	646	434	518	1,647	1,188	612
839	544	11,099	9,753	468	789	611	720	2,372	1,652	883
796	513	14,161	12,229	481	816	607	737	2,625	1,704	704
1,107	481	17,223	14,706	495	864	604	754	2,878	1,757	926
1,055	440	13,988	12,145	361	836	452	623	2,210	1,575	727
989	449	13,388	11,357	461	734	465	691	2,279	1,613	743
865	330	12,801	10,463	312	587	320	553	1,802	1,244	541
1,217	407	16,295	13,645	411	845	382	692	2,033	1,492	659
1,434	512	20,067	16,916	476	946	449	794	2,370	1,725	822
1,434	428	20,182	17,301	391	916	449	739	2,284	1,554	726
1,684	424	22,886	21,164	472	1,088	465	802	2,890	1,808	895
2,176	478	27,357	25,441	561	1,111	521	880	3,321	2,031	909
2,472	569	29,290	29,989	526	1,156	517	901	3,367	2,150	966
2,663	577	33,856	34,053	607	1,422	567	989	4,084	2,447	1,153
2,767	597	31,970	34,261	610	1,582	594	1,029	4,002	2,472	1,105
2,584	549	30,916	33,884	580	1,462	502	998	3,683	2,012	851
2,620	562	32,953	34,055	577	1,389	501	974	3,698	2,257	973
2,730	572	34,402	34,637	589	1,434	501	996	3,805	2,312	988
2,840	582	35,851	36,218	601	1,478	501	1,018	3,912	2,366	1,002
2,950	592	37,300	37,800	613	1,523	501	1,040	4,019	2,421	1,017
3,060	602	38,749	39,382	625	1,567	501	1,062	4,127	2,476	1,031
3,170	612	40,197	40,963	637	1,612	501	1,084	4,234	2,530	1,046
3,280	622	41,646	42,545	649	1,656	501	1,106	4,341	2,585	1,060
3,390	632	43,095	44,126	661	1,701	501	1,128	4,448	2,639	1,075
3,500	642	44,544	45,708	673	1,745	501	1,150	4,555	2,694	1,089
3,610	652	45,993	47,290	686	1,790	501	1,172	4,663	2,749	1,104
3,720	662	47,441	48,871	698	1,834	501	1,193	4,770	2,803	1,118

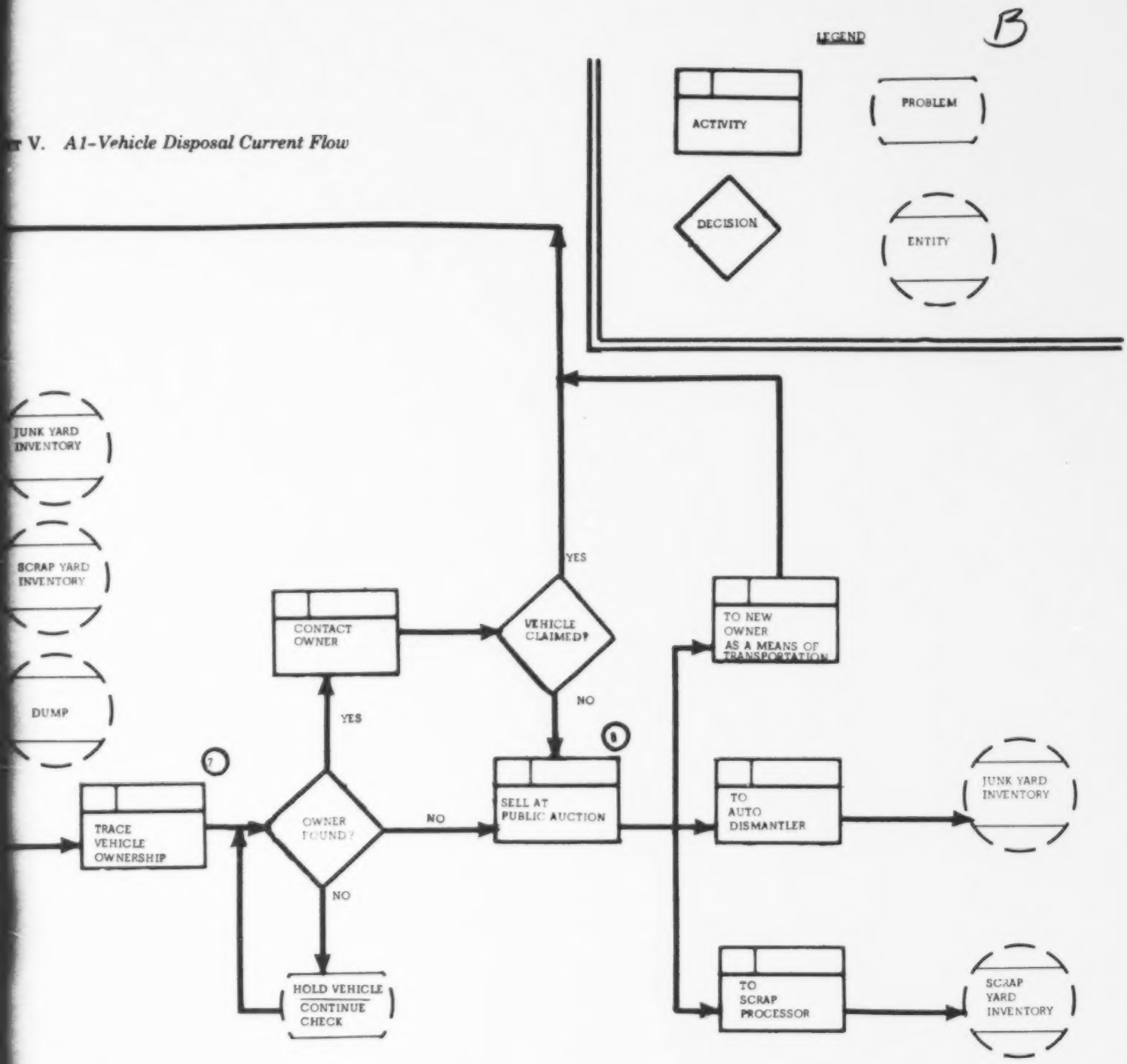
A

EXHIBIT V. *A1-Vehicle Disposal Cur*



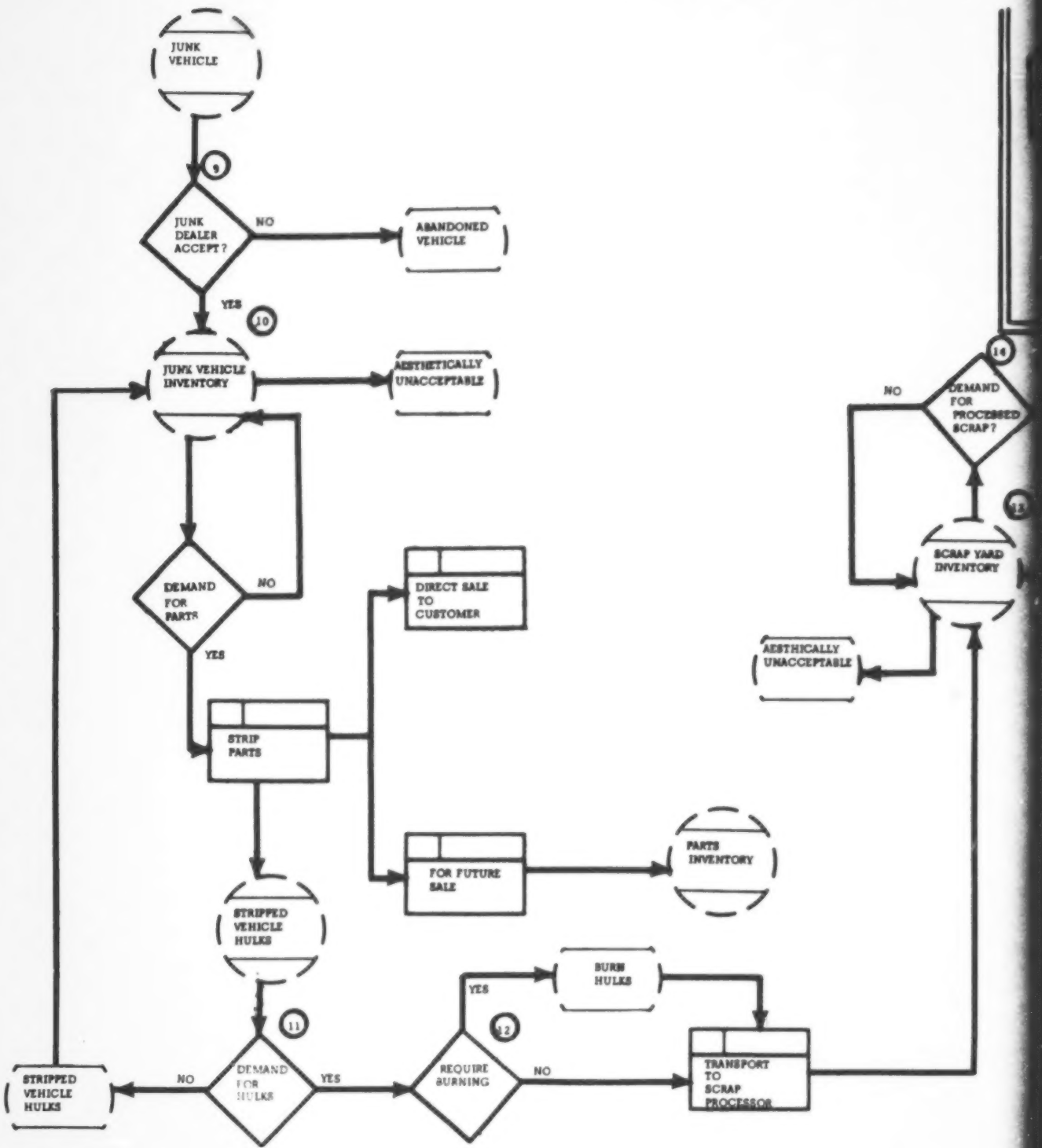
B

V. *A1-Vehicle Disposal Current Flow*



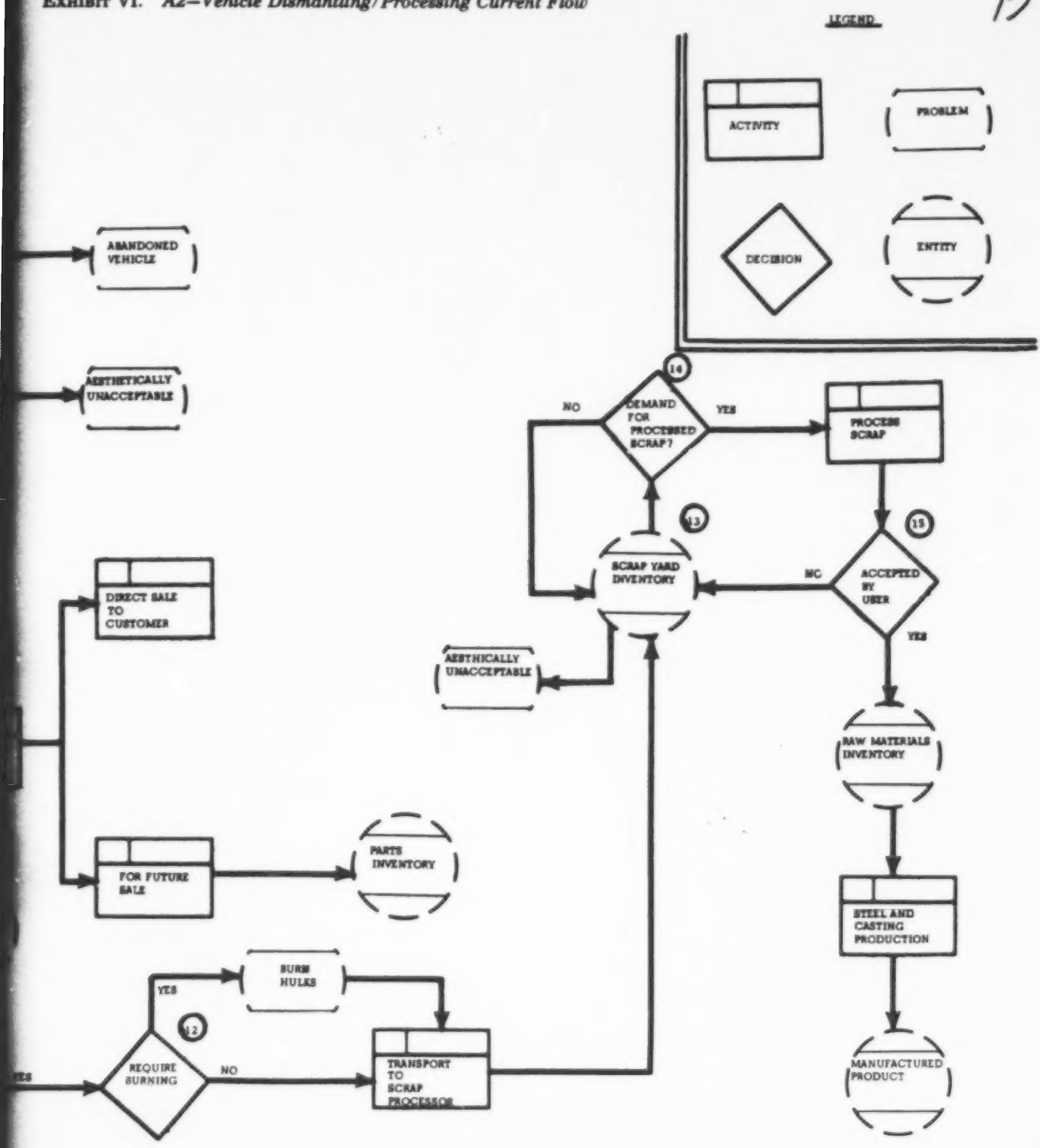
A

EXHIBIT VI. *A2—Vehicle Dismantling/Processing Current Flow*



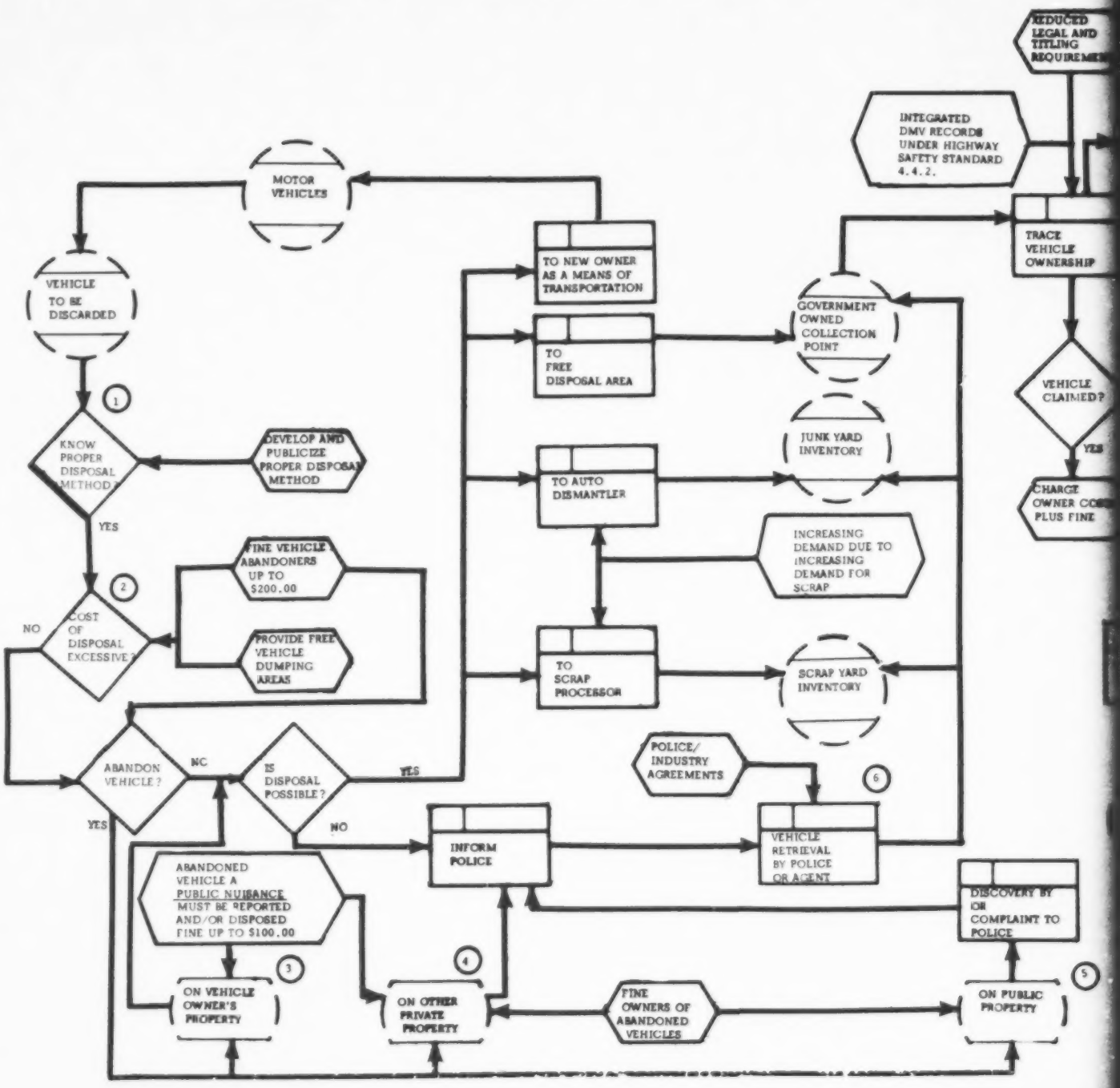
378-864 O - 70 (Face p. 58) No. 4

EXHIBIT VI. *A2–Vehicle Dismantling/Processing Current Flow*

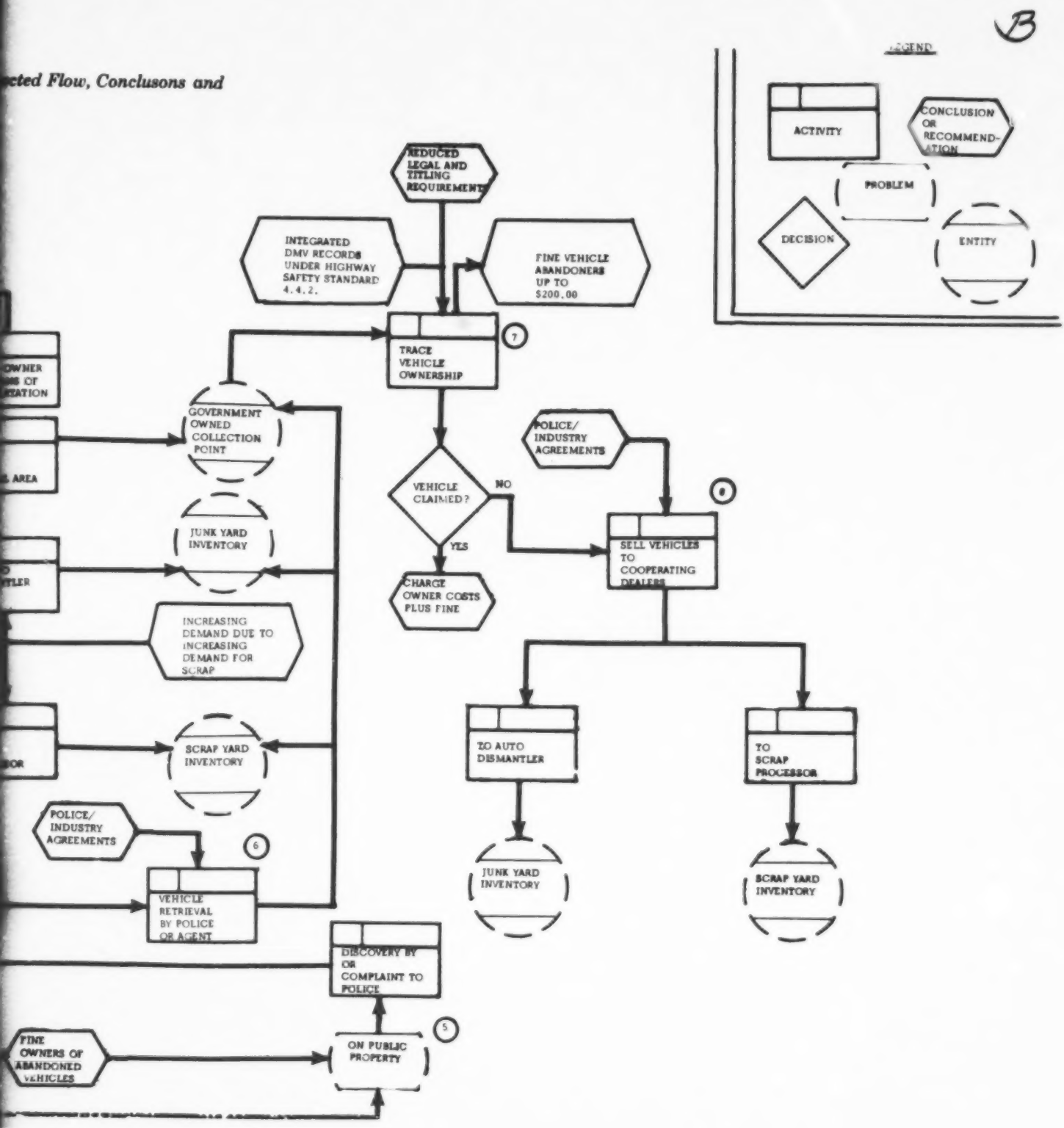


A

EXHIBIT VII. *B1—Vehicle Disposal (Projected Flow, Conclusons and Incorporating Recommendations)*

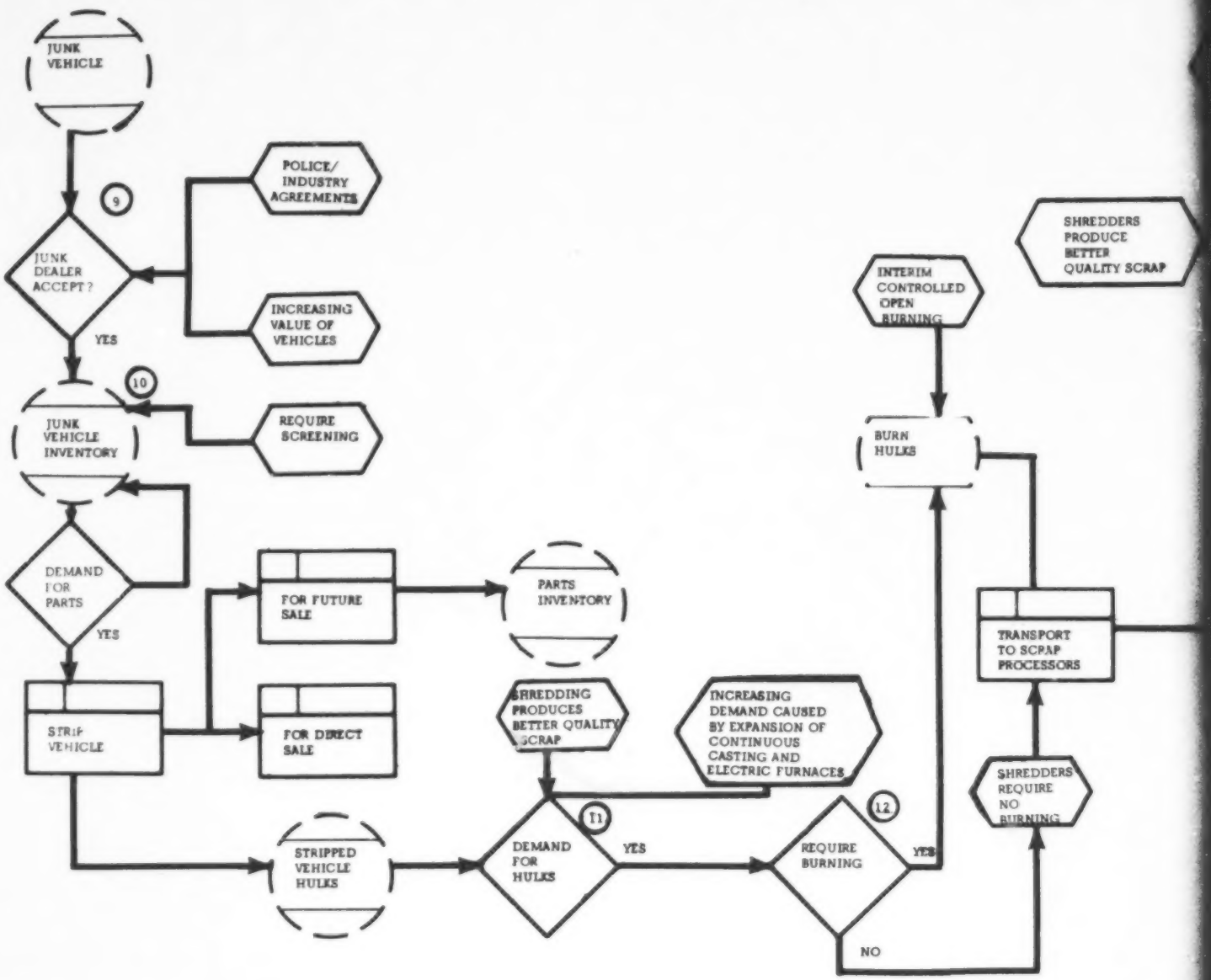


378-884 O - 70 (Face p. 58) No. 8

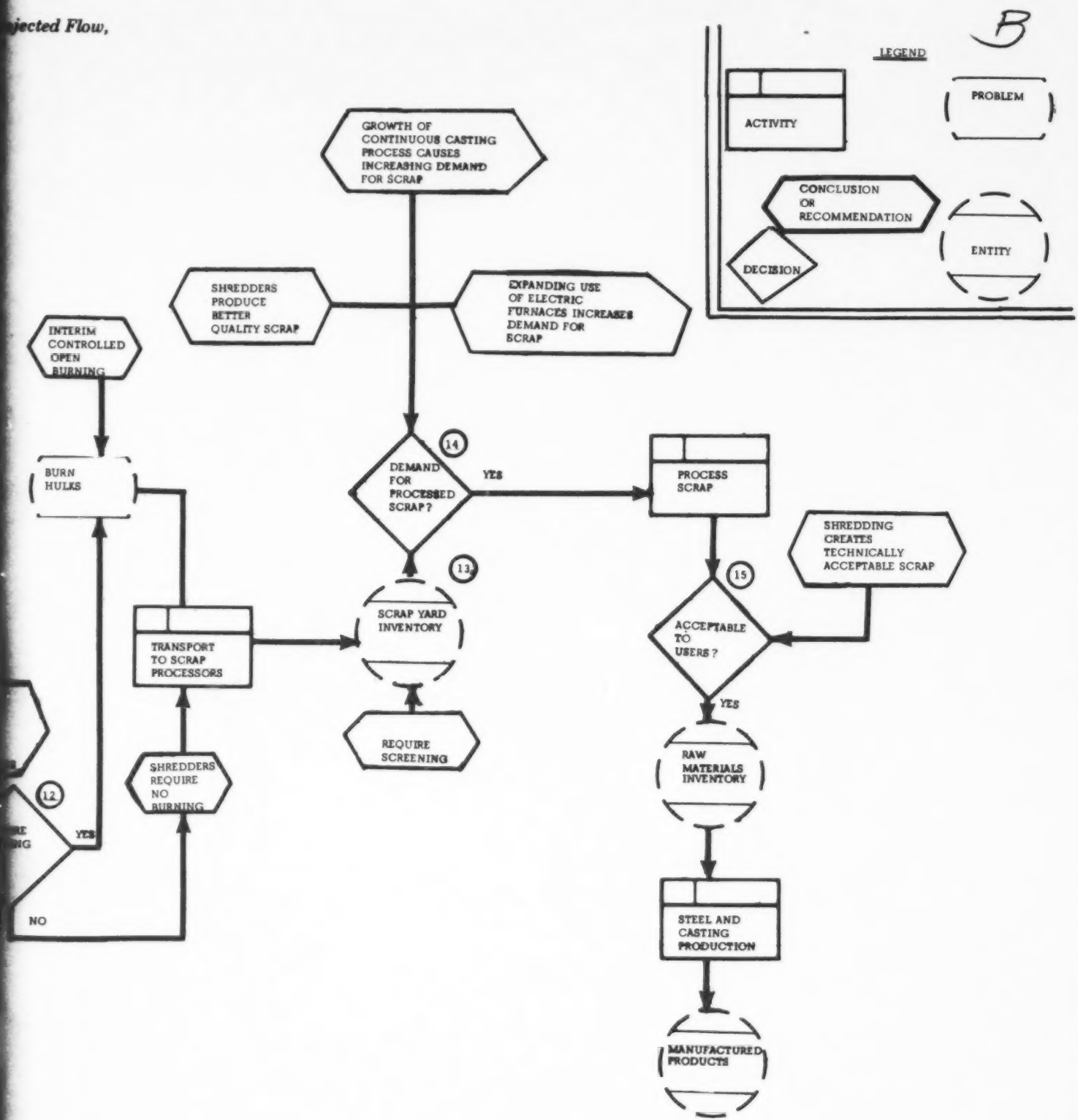

B
LEGEND
ACTIVITY
CONCLUSION OR RECOMMEND-ATION
PROBLEM
DECISION
ENTITY
REDUCED LEGAL AND TITLING REQUIREMENTS
INTEGRATED DMV RECORDS UNDER HIGHWAY SAFETY STANDARD 4.4.2.
FINE VEHICLE ABANDONERS UP TO $200.00
TRACE VEHICLE OWNERSHIP
7
GOVERNMENT OWNED COLLECTION POINT
JUNK YARD INVENTORY
INCREASING DEMAND DUE TO INCREASING DEMAND FOR SCRAP
SCRAP YARD INVENTORY
POLICE/ INDUSTRY AGREEMENTS
6
VEHICLE RETRIEVAL BY POLICE OR AGENT
VEHICLE CLAIMED?
NO
YES
CHARGE OWNER COSTS PLUS FINE
POLICE/ INDUSTRY AGREEMENTS
8
SELL VEHICLES TO COOPERATING DEALERS
TO AUTO DISMANTLER
TO SCRAP PROCESSOR
JUNK YARD INVENTORY
SCRAP YARD INVENTORY
DISCOVERY BY OR COMPLAINT TO POLICE
5
ON PUBLIC PROPERTY
FINE OWNERS OF ABANDONED VEHICLES

A

EXHIBIT VIII. *B2—Vehicle Dismantling/Processing (Projected Flow, Incorporating Conclusions and Recommendations)*



jected Flow,


B
LEGEND
ACTIVITY
PROBLEM
CONCLUSION OR RECOMMENDATION
DECISION
ENTITY
GROWTH OF CONTINUOUS CASTING PROCESS CAUSES INCREASING DEMAND FOR SCRAP
SHREDDERS PRODUCE BETTER QUALITY SCRAP
EXPANDING USE OF ELECTRIC FURNACES INCREASES DEMAND FOR SCRAP
INTERIM CONTROLLED OPEN BURNING
BURN HULKS
14
DEMAND FOR PROCESSED SCRAP?
YES
PROCESS SCRAP
SHREDDING CREATES TECHNICALLY ACCEPTABLE SCRAP
13
SCRAP YARD INVENTORY
15
ACCEPTABLE TO USERS?
TRANSPORT TO SCRAP PROCESSORS
YES
REQUIRE SCREENING
RAW MATERIALS INVENTORY
SHREDDERS REQUIRE NO BURNING
12
YES
NO
STEEL AND CASTING PRODUCTION
MANUFACTURED PRODUCTS